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The Engineer.

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VOL. CXLIII.—No. 3719] LONDON: FRIDAY EVENING, APRIL 22, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Royal Corps of Naval Constructors.

A COMPETITIVE EXAMINATION for a POST as PROBATIONARY ASSISTANT CONSTRUCTOR will be held at the Royal Naval College, Greenwich, during the first fortnight in July next.

The Regulations may be obtained from the SECRETARY OF THE ADMIRALTY (C.E. Branch), Whitehall, S.W. 1, to whom intending candidates must submit their names and full particulars of their educational and technical training and practical experience not later than the 30th April, 1927.

Candidates must be not more than 24 years of age on the 1st October next.

Applications for the Regulations should be accompanied by an addressed envelope.

PRIVATE STUDENTS OF NAVAL ARCHITECTURE.

In conjunction with the above Examination there will be a QUALIFYING EXAMINATION for the admission of Private Students of Naval Architecture to the Royal Naval College, Greenwich.

Applications for the Regulations should be made as in the case of the Examination for the post of Probationary Assistant Constructor (see above).

Private Students are required to pay a fee of £50 a session whilst at the College. 5261

Crystal Palace School of Practical Engineering.

Founded 1872.

MECHANICAL AND CIVIL ENGINEERING DIVISIONS.

PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5180

In the High Court of Justice 1926 C. 055
Chancery Division
Mr. Justice Tomlin
In the Matter of CROFTS (ENGINEERS) LIMITED and REDUCED and
In the Matter of the COMPANIES (CONSOLIDATION) ACT 1908

Notice is Hereby Given that the Order of the High Court of Justice, Chancery Division, dated the 29th day of March, 1927, confirming the reduction of the capital of the above-named Company from £250,000 to £150,000 and the Minute approved by the Court showing with respect to the share capital of the Company as altered the several particulars required by the above Act, were registered by the Registrar of Companies on the 14th day of April 1927.

Dated this 14th day of April 1927.

JAMES B. SOMERVILLE,
11, New-square, Lincoln's Inn, London, W.C. 2,
Agent for F. G. and H. E. Smith, 33, Kirkgate, Bradford, Yorkshire, Solicitors for the said Company. 5275

City of Liverpool.

BATHS AND WASHHOUSES DEPARTMENT.

The Corporation invite TENDERS for CORNISH BOILER and FEED PUMP.

Specification may be obtained from the Engineer and Chief Superintendent of Baths, 75, Dale-street, Liverpool, on payment of Half a Guinea, returnable to senders of bona fide Tenders.

Tenders must be delivered by letter post at the Town Clerk's Office (in the envelope provided) not later than Noon on Wednesday, May 11th, 1927.

The Corporation do not bind themselves to accept the lowest or any Tender.

WALTER MOON,
Town Clerk.

Town Clerk's Office, Liverpool,
20th April, 1927. 5278

County Borough of Warrington.

WATER DEPARTMENT.

TENDERS FOR STEEL WATER PIPES.

The Water Committee invite TENDERS for the SUPPLY and DELIVERY to a Warrington Station of about 7100 YARDS of 15in. nominal diameter STEEL WATER PIPES, lined internally and protected externally.

Conditions of contract may be obtained upon application to the undersigned.

Tenders to be sent in not later than 7th May, 1927.

The Water Committee do not bind themselves to accept the lowest or any Tender.

JAMES GRAY,
Waterworks Engineer.

Municipal Offices, Warrington,
13th April, 1927. 5287

Port of Bristol Authority.

EXTENSION OF THE ROYAL EDWARD DOCK, AVONMOUTH.
CONSTRUCTION OF THE EASTERN ARM.
DREDGING.

The Port of Bristol Authority is prepared to receive TENDERS for DREDGING at the Eastern Arm of the Royal Edward Dock, Avonmouth.

On and after Tuesday, the 19th April, 1927, copies of the specification and contract drawing can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid. ALL CHEQUES MUST BE MADE PAYABLE to the "PORT OF BRISTOL AUTHORITY" and forwarded to the General Manager and Secretary, Dock Office, 19, Queen-square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Dredging, Eastern Arm, Royal Edward Dock, Avonmouth," and addressed to the General Manager and Secretary of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him accompanied by all the prescribed documents and drawings before 10 a.m. on Wednesday, the 11th day of May, 1927.

The Port of Bristol Authority does not bind itself to accept the lowest or any Tender.

THOMAS A. PEACE,
Chief Engineer.

Chief Engineer's Office,
Avonmouth Docks, Bristol,
11th April, 1927. 5247

COOKING APPARATUS.

The Committee of Visitors of the County Mental Hospital, Prestwich, invite TENDERS for the SUPPLY and FIXING of GAS-HEATED or ELECTRICAL COOKING APPARATUS and other EQUIPMENT at the Annexe Kitchen.

Full particulars may be obtained on application at the Hospital or by letter from the undersigned.

A. R. DOWLING,
Clerk and Steward.
5279

The Engineer

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ARRANGED FOR CARD INDEXING.

A New Method of Making Beet Sugar.
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The Modern Steam Engine and Internal Combustion Motors—No. II.
(MAURICE DEMOULIN.) THE ENGINEER, 22-4-27.

Institution of Naval Architects—No. III.
THE ENGINEER, 22-4-27.

Proposed Battleship for Coast Defence.
THE ENGINEER, 22-4-27.

Paint Making Machinery—No. III.
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Internal Combustion Locomotives—No. II.
(E. KITSON CLARK.) THE ENGINEER, 22-4-27.

Goodwill in Industry.
THE ENGINEER, 22-4-27.

The Effect of Wind on the Power and Speed of Vessels.
(H. J. R. BILES.) THE ENGINEER, 22-4-27.

A New Rotary Pump.
THE ENGINEER, 22-4-27.

PUBLIC NOTICES

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) GIRDERS (Spans of various sizes from 6ft. to 40ft., approximate total weight equals 236 tons.

(2) 53 COPPER FIRE-BOX PLATES.

Tenders are due in on Tuesday, 10th May, 1927, as follows :—No. (1) by 10.30 a.m., No. (2) by 2 p.m.

Tender forms obtainable at above address; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 5307

Scarborough Corporation.

NEW IRTON WATER SCHEME.—
CONTRACT NO. 2.
PUMPING MACHINERY.
TO ELECTRICAL AND PUMPING MACHINERY CONTRACTORS.

The Corporation invite TENDERS for the complete INSTALLATION of a HIGH-CLASS ELECTRICAL PUMPING SET in DUPLICATE.

Each pumping set will consist of a Low-lift Vertical Bore-hole Centrifugal Pump driven by an Electric Motor, and Two High-lift Centrifugal Force Pumps with Two Electric Motors. The low-lift pumps to pump 110,000 gallons per hour against a head of about 30ft. inclusive of friction, and the high-lift pumps 55,000 gallons per hour against a head of about 300ft. including friction. The plant is to be complete in all details with certain specified accessories.

Copies of the conditions, specification, schedule of prices and form of Tender, prepared by the Engineer, Dr. Herbert Lapworth, M. Inst. C.E., 25, Victoria-street, Westminster, may be obtained on application to the Town Clerk on or after Friday, April 22nd, 1927. The application must be accompanied by a sum of £5, which will be refunded on return of the documents within seven days or after the receipt of a bona fide Tender and the documents required.

Facilities for inspecting the site and general information can be obtained on application to Mr. Herbert Richardson, M. Inst. W.E., Water Engineer, and Mr. M. B. Mawson, M. Inst. C.E., Resident Engineer, Town Hall, Scarborough.

Tenders are to be sent in on the form supplied and with the annexed documents must be enclosed in a sealed cover, endorsed "New Irton Scheme: Tender for Contract No. 2," addressed to and reaching the undersigned, the Town Clerk, not later than 10 a.m. on Friday, June 3rd, 1927.

Only Tenders from manufacturers experienced in the required type of plant will be considered.

The Corporation do not bind themselves to accept the lowest or any Tender.

SYDNEY JONES,
Town Clerk.

Town Hall, Scarborough,
11th April, 1927. 5281

PUBLIC NOTICES

The South Indian Railway COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. STEEL TYRES FOR LOCOMOTIVE ENGINES AND TENDERS.
2. BEST YORKSHIRE IRON.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Steel Tyres for Locomotive Engines and Tenders," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 6th May, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specification No. 1, and of 5s. for each copy of Specification No. 2.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1,
20th April, 1927. 5302

Brighton Intercepting and OUTFALL SEWERS BOARD.

APPLICATIONS are INVITED for the APPOINTMENT of a RESIDENT ENGINEER in connection with the Construction of the Sewer Outfall and Sea Wall at Portobello, near Brighton.

Probable duration of work about two years.

Salary Eight Guineas per week.

Applications, stating age and previous experience, with copies of three recent testimonials, should reach the undersigned not later than Monday, April 25th, 1927.

DAVID EDWARDS, M. Inst. C.E., F.S.I.,
Engineer to the Board.

Town Hall, Brighton,
8th April, 1927. 5234

Clacton Urban District Council.

APPOINTMENT OF COSTS CLERK.

The above Council invite APPLICATIONS for the APPOINTMENT of a COSTS CLERK in the Accountant's Department for Gas, Water, Electricity and Surveyor's Accounts. Salary £208 per annum.

Applicants, who must have had previous experience in a costing department, should apply in own handwriting, stating age, experience, and qualifications.

Applications, accompanied by copies of two recent testimonials, should be sent to the undersigned on or before Wednesday, 6th May next, endorsed "Costs Clerk."

GEO. T. LEWIS,
Clerk to the Council.

Council Offices, Clacton-on-Sea. 5308

PUBLIC NOTICES

City of Leicester.

MECHANICAL ENGINEERING ASSISTANT.

APPLICATIONS are INVITED from qualified MECHANICAL ENGINEERS, who must be well versed in up-to-date methods and practice in regard to Engines, Boilers, Pumps and Machinery; competent to undertake inspections during construction and to carry out working tests, &c.; inspect and test Iron and Steel Work required for contracts; also to prepare drawings and specifications for machinery of all kinds.

Commencing salary £350 per annum (Grade F).

The position is an established post under the Local Government and Other Officers' Superannuation Act, 1922, and the successful candidate will be required to pass a medical examination and to contribute to the Fund.

Applications must be made upon the forms which may be obtained from me on receipt of a stamped foolscap envelope, and must be delivered not later than Saturday, April 30th next.

A. T. GOOSEMAN, M. Inst. C.E.,
City Engineer and Surveyor.

Town Hall, Leicester,
April 12th, 1927. 5257

London County Council.

DIVISIONAL ENGINEER (MECHANICAL) IN THE CHIEF ENGINEER'S DEPARTMENT.

The London County Council invites APPLICATIONS from qualified Mechanical Engineers for the POSITION of DIVISIONAL ENGINEER (MECHANICAL) in the Department of the Chief Engineer of the Council. Candidates who did not serve in H.M. Armed Forces during the Great War must be natural-born British subjects. The scale of salary attaching to the position is £700 a year, rising by annual increments of £50 to £800 a year, and is at present subject to temporary additions on the Civil Service scale, fluctuating according to the cost of living. On the existing basis the total minimum remuneration is £913 17s. 6d., and the maximum £1023 8s. 11d. The next revision of the temporary additions will take place not later than 1st September, 1927.

Candidates must possess recognised qualifications as mechanical engineers and have occupied positions of responsibility in the conduct of work and the supervision and management of the staff of a drawing-office. Preference will be given to candidates who served or attempted to serve in H.M. Forces during the Great War.

Applications must be made on the official form, which contains particulars of the nature of the duties and conditions of appointment and copies of which may be obtained by sending a stamped addressed foolscap envelope, marked "Divisional Engineer (Mechanical)," to the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1. Forms must be returned not later than Tuesday, 10th May 1927. Canvassing disqualifies.

MONTAGU H. COX,
5251 Clerk of the London County Council.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, Brilliant SALESMAN REPRESENTATIVE, good organiser, to join in formation of subsidiary; £2000 to £7000 wanted. Influence with engineering and shipbuilding firms an essential. Highest credentials. Particulars in confidence.—Address, P3088, The Engineer Office. P3088 A

WANTED for MIDLAND DISTRICT, First-class CONSTRUCTIONAL ENGINEER, used to Colliery, Bridge, and general constructional work. Must be capable of taking out stresses, and taking charge of all office work, including estimating, costing, and general designing. Only practical and energetic men over 30 years of age need apply, giving full references and details of career which will be treated as confidential. State salary, and when at liberty.—Address, 5195, The Engineer Office. 5195 A

WANTED, Thoroughly Trained MAN for POST as WORKS MANAGER (must have held similar position), Boilermaking, Engineering and Repairing Works, South-East England. Output about 2000 tons per annum, widely diversified classes of work. Knowledge of up-to-date methods and piecework prices necessary.—Address full particulars, references, age, salary, &c., 5300, The Engineer Office. 5300 A

A LARGE INDUSTRIAL CORPORATION REQUIRES the SERVICES of an ENGINEER SUPERINTENDENT for one of its factories. First-class Mechanical and Electrical experience essential; Industrial experience and a knowledge of Power and Steam Generation and Distribution desirable. Commencing salary £1500 per annum. Prospects excellent.—Applications (in writing only) should give full particulars of education, training, experience, and technical qualifications, and should be addressed to "ENGINEER SUPERINTENDENT," c/o Sir Alexander Gibb and Partners, Queen Anne's Lodge, Westminster, S.W. 1. 5274 A

MECHANICAL ENGINEER, Experienced in Oil Installations and Can Making, REQUIRED as GENERAL SUPERINTENDENT abroad; knowledge of Spanish desirable. State age and full particulars of training and experience. Good salary offered for right man.—Write, Box J. 626, Willings, 133, Moorgate, E.C. 2. P3080 A

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SITUATIONS OPEN (continued)

INSTRUMENT MAKER WANTED for Experimental Work; must have had good all-round machine and bench experience. Permanency for suitable man. Wages about £4. Hostel accommodation if unmarried. Fares paid for interview in Bollington or London and for trial period.—Applicants willing to undergo fortnight's trial should send full particulars of experience, stating age and whether married, to SECRETARY, Experimental Department, Fine Cotton Spinners' and Doublers' Association, Rock Bank, Bollington, Macclesfield. 5277 A

MERCHANT FIRM, with Excellent Offices in Westminster and experienced staff, is OPEN to ACT on very reasonable terms as LONDON REPRESENTATIVES of Iron, Steel or Engineering Manufacturers.—Write, "E.W.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, London, E.C. 2. 5301 A

REPRESENTATIVES with Engineering Training REQUIRED to push Electric Boiler Scaling Tool in Midlands, Yorkshire, East and South Coasts. Good commission. State area covered, age, experience. —Address, P3066, The Engineer Office. P3066 A

REQUIRED, ENGINEER, Fully Competent in Surveying and Setting Out, also with thorough general knowledge Construction Work, including Hydraulics.—Address, stating experience, salary required, and if willing to go abroad, in which case languages written and spoken, 5289, The Engineer Office. 5289 A

REQUIRED IMMEDIATELY, Fully Competent ENGINEER as Leading Designer in Steel Bridge Design, also with knowledge of Bowstring, Warren Truss Girders and Plate Girders.—Address, stating experience, salary required, and if willing to go abroad, in which case languages spoken and written, 5288, The Engineer Office. 5288 A

STEAM SUPERINTENDENT, to Take Charge of Large Steam-raising Plant at Chemical Works. State age, qualifications, experience, and salary.—Address, 5294, The Engineer Office. 5294 A

STRUCTURAL STEEL WORK DESIGNER WANTED IMMEDIATELY by Large Firm, East of Scotland. Must be first-class man with all-round experience. State age, salary, and when free.—No. 226, Keith and Co., Advertising Agents, Edinburgh. 5309 A

WANTED, First-class DRAUGHTSMAN; Must be familiar with designing Chemical, Oil and Gas-works Plant. Only competent men need apply.—Address, 5286, The Engineer Office. 5286 A

AN Experienced DRAUGHTSMAN is REQUIRED for the Development of Printing Machinery. A knowledge of Off-set Work is essential. Give full particulars of experience and state age and salary required.—Address, 5232, The Engineer Office. 5232 A

CHIEF DESIGNER WANTED.—A Well-known FIRM of CRANE BUILDERS in the North of England DESIRE the SERVICES of a thoroughly experienced LEADING DRAUGHTSMAN for Cranes of all types and similar Engineering Work.

Only those capable of designing without supervision need apply.

A competent man will be assured of a permanent position and progressive salary.

State age, full details of experience, and when at liberty.

Address, 5236, The Engineer Office. 5236 A

DRAUGHTSMAN WANTED, Age About 30, capable of Designing Modern Coal and Coke Elevators and Conveyors, and with good experience in General Mechanical Details. State full particulars and salary required.—Address, 5202, The Engineer Office. 5202 A

DRAUGHTSMAN WANTED, Thoroughly Experienced, with knowledge of details and lay-out of Mining and Milling Machinery and Structures.—Apply, stating age, experience, and salary required, FRASER and CHALMERS ENGINEERING WORKS, Erith, Kent. 5306 A

DRAUGHTSMAN with Experience in Designing and Estimating Quantities for large Conveying Plants WANTED for Engineering Works in North Midlands.—Address, 5291, The Engineer Office. 5291 A

HEATING ENGINEER, DRAUGHTSMAN, Experienced in Central Heating Work; also JUNIOR WANTED for drawing-office.—Write, stating qualifications and salary, to HENRY HOPE and SONS, Ltd., 59, Berners-street, W. 1. 5285 A

JUNIOR DRAUGHTSMAN or IMPROVER. State experience and salary.—CRADLEY BOILER CO., Ltd., Cradley Heath, Staffs. 5295 A

MECHANICAL DRAUGHTSMAN REQUIRED Temporarily for Office of Large Industrial Concern. One accustomed to Machine Design and Plant Lay-out preferred.—Address, P3076, The Engineer Office. P3076 A

SITUATIONS WANTED

CIVIL ENGINEER OPEN to UNDERTAKE SETTING-OUT of WORKS. Contracts carried through by periodic visits. Water, Railway, Sewage, &c. &c.—Address, P3058, The Engineer Office. P3058 B

COST ACCOUNTANT, with Organising Ability, DESIRES responsible POSITION. Expert in modern methods of costing (controlling accounts), foundry, forge, machine shops, &c. Thoroughly conversant with all commercial work appertaining to engineering. At present holds responsible position in large engineering works. Excellent references.—Address, P3078, The Engineer Office. P3078 B

DISENGAGED ENGINEER (35) DESIRES POSITION; 14 years' experience in charge boilers, engines, turbo-generators, refrigerating machinery, pump, &c.—Address, P3082, The Engineer Office. P3082 B

ENGINEER MANAGER, with Wide Experience, practical, technical and commercial, is OPEN for APPOINTMENT. First-class sales management.—Address, P3084, The Engineer Office. P3084 B

ENGLISHMAN (23), Diploma in Electrical Engineering, 2 years' works experience and 2½ years in drawing-office, DESIRES POST, home or abroad.—Address, P3077, The Engineer Office. P3077 B

EXPERIENCED MAN, British, Fluent Spanish, OPEN to ENGAGEMENT, home or abroad, in executive capacity. Accountancy, organisation and special all-round knowledge Mineral Separation Plants, Mining and Railway Machinery. Highest references.—"E. M. 207," c/o Deacon's, Fenchurch-avenue, E.C. 3. 5299 B

WORKS MANAGER DESIRES POST with Medium-sized Firm, or Assistant in Large Firm. Could introduce good proven lines and own patent.—Address, P3085, The Engineer Office. P3085 B

A YOUNG MAN, with Some Previous D.O., Workshops and clerical experience, WANTS POST as Junior Draughtsman and Tracer or Office Work (can use typewriter). Would accept low salary to commence.—Address, P3083, The Engineer Office. P3083 B

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 75 years.

If you wish to purchase or sell a Business connected with the Engineering or allied Industries consult:
HENRY BUTCHER, HALL & CO.,
63 & 64, CHANCERY LANE, LONDON, W.C. 2.

AN Old-Established Engineering Firm (Manchester District), well known all over the world, REQUIRES an ENERGETIC ENGINEER, with £10,000 to £20,000, to invest for new developments and to take an active interest in the management. State full particulars and experience.—Address, P3027, The Engineer Office. P3027 C

TO Cope with Expanding Business, INDUSTRIAL CONCERN REQUIRES well-educated MAN, capable, active (whole-time) DIRECTORSHIP, invest about £2000, fully secured, good profits.—Address, P3081, The Engineer Office. P3081 C

TO GENTLEMAN WANTING INVESTMENT.—A Small LIMITED COMPANY manufacturing materials allied to engineering REQUIRES £5000 to £7000; £4000 building as guarantee for this amount, balance as investment. Wonderfully interesting business.—Address in confidence, P3087, The Engineer Office. P3087 C

MISCELLANEOUS

ENGINEERS.—If You Hold A.M.I. Mech. E., A.M.I.A.E., or A.M.I.E.E., &c., your future is assured. Our FREE 84-pp. book "ENGINEERS' GUIDE TO SUCCESS" will show you how to obtain any Engineering qualification easily; 40 Engineering Diploma Courses also described.—Write now, stating branch or Examination which interests you, to TECHNOLOGICAL INSTITUTE, 76, Thanet House, 231, Strand, London. P3019 I

EVERY STRUCTURAL DRAUGHTSMAN Should have Clarke's "Table of Beam Connection Loadings for Standard Cleats on Standard Beams." Post free 1s. 7½d. from the Publisher.—CLARKE, 210, Gloucester-terrace, W. 2. P3075 I

"MODERN MECHANICAL ENGINEERING." A. H. GIBSON, D.Sc., and ALAN E. L. CHORLTON, C.B.E. 1923. 6 Vols. Originally £5. No reasonable offer refused.—Box A, W. H. Smith and Son, High-street, Huntingdon. P3074 I

MRS. GALLINO, Neuchatel (Switzerland) RECEIVES PUPILS or YOUNG LADIES wishing to learn French and complete education. Beautiful situation near woods. Tennis, lake bathing, winter sports.—Apply, Mrs. HENRY MAINE, 5, Binagardens, London, S.W. P3071 I

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. Civil Engineers, Inst. Mech. E., London Univ., and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Eng., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.R.S.I., F.R.S.A., &c. Excellent results at all Exams., comprising hundreds of successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 8/11, TRAFFORD CHAMBERS, 58, SOUTH JOHN-STREET, LIVERPOOL. Tel. No., Bank 1118.—London Office: 65, Chancery-lane, W.C. 2. Ex. E

DRAUGHTSMANSHIP.—The Highest Salaries and Permanent Administrative Appointments are offered to men with a thorough knowledge of Mechanical Draughting. Enrol for my short intensive Home-Study Tuition, which gives you the choice of Mechanical, Civil, Structural, Electrical, or Motor Engineering Courses in Draughtsmanship. If you are a candidate for a Technical Examination, don't be one of those who fail through "Weakness in Drawing."—Send for booklet, stating which course you are interested in.—PERCY PITMAN, M.I. Mech. E., 25, Victoria-street, London, S.W. 1 (Established 1894).

PATENTS

KING'S PATENT AGENCY, Ltd. (Director, B. T. KING, C.I.M.E., Registered Patent Agent, G.B., U.S., and Canada). Inventions advice handbook and consultations free.—146A, Queen Victoria-street, London, E.C. 4. 40 years' refs. 'Phone: Central 682. 5087 H

THE PROPRIETOR of LETTERS PATENT No. 206,182, relating to "Improvements in Air Admission Devices for Internal Combustion Engines," DESIRES to DISPOSE of his PATENT or to GRANT LICENCES to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.

Inquiries to be addressed to—
CRUIKSHANK and FAIRWEATHER,
Chartered Patent Agents,
5260 H 65-66, Chancery-lane, London, W.C. 2.

THE PROPRIETORS of LETTERS PATENT No. 178,129, relating to "An Improved Method of and Arrangement for Utilising Heat in Steam Heating Apparatus," DESIRE to DISPOSE of the PATENT or to GRANT LICENCES to interested parties at reasonable terms with a view to the adequate working of the patent in Great Britain.—Inquiries to be addressed to H. HYLANDER, Engineer, c/o Aktiebolaget Zander and Ingestrom, Fredsgatan 4, Stockholm, Sweden. 5283 H

THE PROPRIETOR of BRITISH PATENT No. 168,158, dated May 31, 1920, relating to "A Method or Process of Operating Augers," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, 23, East Jackson Blvd., Chicago, Illinois. 5310 H

PATENTS

THE PROPRIETORS of LETTERS PATENTS No. 176,304, relating to "Improvements in or relating to Fuel Injecting Apparatus for Internal Combustion Engines;" No. 163,671, relating to "Improved Manufacture of Barrels and Casks;" No. 163,672, relating to "Improved Manufacture of Barrels and Casks;" No. 205,483, relating to "Improvements in Ignition Devices for Internal Combustion Engines;" No. 220,534, relating to "Improvements in or relating to Means for Regulating the Supply of Liquid Fuel to Internal Combustion Engines;" No. 218,609, relating to "Improvements in or relating to Fuel Pumps for Internal Combustion Engines;" No. 217,925, relating to "Improvements in or relating to Reversing Means for Internal Combustion Motors;" No. 234,938, relating to "Improvements in or relating to Fuel Injecting Nozzles;" and No. 236,223, relating to "Improvements in or relating to Woodworking Cutters and the like," DESIRE to DISPOSE of the PATENTS or to GRANT LICENCES to interested parties at reasonable terms with a view to the adequate working of the patents in Great Britain.

Inquiries to be addressed to J. and C. G. BOLINDERS MEKANISKA VERKSTADS AKTIEBOLAG, Kaplansbacken 10, Stockholm, Sweden. 5282 H

MACHINERY, &c., WANTED

WANTED, Good 1000 K.W. Mixed-pressure TURBO-ALTERNATOR, 3300 volts, 50 periods, 3-phase, 150 lb. steam, H.P. 24 lb. gauging on L.P. ejector condenser preferred.—Address, 5290, The Engineer Office. 5290 F

WANTED, LOCOMOTIVE, Second-hand, Recent build, 4-wheel coupled, 14in. cylinders, wheel base 5ft. 6in., standard gauge, copper box, brass tubes, certified working steam pressure 130 lb.—Offers, with price, full particulars of age, make, number, and accompanied by insurance certificates.—Address, 5285, The Engineer Office. 5285 F

WANTED, ONE FULL UNIVERSAL HORIZONTAL MILLING MACHINE, No. 3 Milwaukee, No. 3 Cincinnati, Parkinson, Brown and Sharpe, or other makes, feeds 34in. by 12in. by 9in., single pulley drive preferred.—Address, 5276, The Engineer Office. 5276 F

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The above are lying in South Wales.

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

H.M.S. Adventure Commissioned.

THE commissioning this week of H.M.S. Adventure, for service with the Atlantic Fleet, is an event of some importance from the engineering point of view. This cruiser-minelayer of 7260 tons normal displacement is equipped with a dual system of propulsion. The main engines are Parsons turbines of 40,000 shaft horse-power for a speed of 27·75 knots, but a Diesel plant is also installed, and this, it is understood, will always be used to drive the ship when a moderate cruising speed is desired. No particulars of the Diesel machinery are available. It was built by Vickers Ltd. to Admiralty specifications. The maximum fuel oil stowage of the Adventure is 1550 tons, and she is expected to have the widest radius of action of any ship in the Fleet. Although not the first motor warship, apart from submarines, to be built for the British Navy—several monitors with internal combustion engines were constructed early in the war—the Adventure is the first vessel of cruiser type to have Diesel engines for propulsion, even though they are subsidiary to the steam plant. The experience gained with this ship should provide the Admiralty with valuable data, which cannot fail to influence the further development of the internal combustion engine for naval purposes. Official confidence in the system is shown by the fact that the large submarine depôt ship ordered from Vickers Ltd. last September is to be driven by twin-screw double-acting Diesel engines. The Adventure has a total length of 520ft., with a breadth of 59ft. over the bulges. A tripod foremast and two funnels are fitted, the exhaust from the Diesels being led into the second funnel. She was laid down at Devonport in November, 1922, and has been completed at a total cost of £1,253,955.

Street Accidents in 1926.

IN the Journal of March 18th we referred to the conference on the prevention of street accidents which had been convened by the Ministry of Transport. The necessity for studying and devising new means for the prevention of street accidents is made very clear from the recently issued Home Office report giving particulars of the street accidents which happened during the year 1926. From that report we learn that the total number of persons killed in England and Wales was 4307 and that the number of people injured was 121,783. The figures for Scotland were 579 and 12,105 persons respectively. In England and Wales mechanically propelled vehicles were responsible for 3826 deaths and 95,550 cases of injury. Horse-drawn vehicles accounted for 202 deaths and 4656 cases of injury, whilst 279 people were killed and 21,577 injured in accidents caused by pedal cycles. The figures for Scotland include 520 deaths and 9861 cases of injury caused by mechanically propelled vehicles, twenty-six deaths and 630 cases of injury caused by horse-drawn vehicles, while in pedal cycle accidents 33 persons were killed and 1614 injured. Some districts were remarkably free from fatal accidents, while it is recorded that in the Scilly Isles not a single accident occurred during the year.

The Staff of the National Physical Laboratory.

AN examination of the recently issued report of the National Physical Laboratory yields some interesting statistics concerning the staff required to man a large experimental and research establishment. The seven technical departments and the administrative department between them give employment to 544 people, of whom 115 are women. Under the director there are 6 superintendents, 10 principal assistants, 17 senior assistants, 56 assistants, and 47 junior assistants. Of the assistants 6 and of the junior assistants 2 are women. These officers have the assistance of 6 principal observers, 14 senior observers, 27 observers and 56 junior observers. One of the senior observers, one of the observers, and 2 of the junior observers are women. In addition there are 84 laboratory attendants, of whom 59 are women, 61 clerks and typists, of whom 31 are women, and 69 artificers and mechanics. The remainder of the staff includes 37 porters, packers and labourers, 15 workshop boys and 12 laboratory girls.

Strike Prevention in France.

THE successful manner in which the French Minister of Public Works averted a threatened strike in the Nord and the Pas de Calais by inducing the colliers to accept a reduction in wages is hailed in France as evidence of the triumph of the men's good sense over the influences of communistic agitation. One difference between the British trade unions and the French workmen's syndicates is that, while in one case the men are under the leadership of individuals, they are, in the other, represented by committees which, on every occasion, enter into direct contact with employers and discuss claims relating to wages or other professional matters. In the great majority of cases disputes are settled by compromise because each side is able to understand the view of the other. A settlement of the coal dispute presented particular difficulties. Owners found that they could not dispose of their coal in competition with foreign fuel except by lowering prices, and this step could only be accomplished by a reduction in wages, which the men refused on the ground that the cost of living must come down first. It is quite possible that the failure of the strike in Great Britain may have induced the French miners to pay a readier attention to the economic arguments put before them. They recognised that there could be no hope for a continued prosperity of the colliery industry unless they themselves made a sacrifice, and as the owners took some of the sacrifice on their shoulders an agreement was come to whereby a reduction of wages permitted of an appreciable drop in coal prices. The significance of this settlement lies in the fact that the result was obtained by force of economic arguments. The men were induced to see that selling prices depended on wages, and that when those prices were brought low enough to cheapen production in other industries there was a fall in prices all round, so that the cheapening of commodities would increase the purchasing power of lower wages.

Remarkable Warship Speeds.

THE steam trials of the Spanish cruiser Principe Alfonso, which took place recently, are reported to have been very successful. A run of four hours' duration at full power resulted in a mean output of 83,000 shaft horse-power and a speed of 34 knots, the maximum speed being 34·7 knots. As the contract called for 80,000 shaft horse-power and 33 knots, this performance was highly creditable. The Principe Alfonso is now claimed by the Spanish Press to be the swiftest cruiser in the world. Her only possible rival is the U.S. Omaha, which is reputed to have developed 94,290 shaft horse-power and 34·87 knots on a trial run early in 1923. The point could only be settled by determining how far the draught of each vessel at the time of the trials corresponded to the legend displacement. The two ships of the "Principe Alfonso" class were designed by the late Sir Philip Watts and were probably the last warships for the plans of which he was responsible. They bear a close resemblance to our cruisers of the "E" class. The normal displacement is 7850 tons, the machinery comprising Parsons turbines with gearing and eight Yarrow oil-burning boilers. The main armament of eight 6in. guns is distributed along the centre line, with six of the guns twin mounted. The name ship was launched in January, 1925, the Almirante Cervera in the October following, and a third vessel of the same class, Miguel de Cervantes, was begun last year. Another Spanish warship, the Churruca, holds the world's speed record for flotilla leaders. She was launched at Cadiz in 1925. She displaces 1650 tons and has Parsons geared turbines of 42,000 shaft horse-power. On her full-power trial she maintained an average of 37·64 knots, the highest recorded speed being 39·76. These remarkable figures, which are official, furnish a striking tribute both to the British designers of the ship and the Spanish craftsmen who built her.

An Electrical Contract for Sweden.

PARTLY on account of price and partly because there appeared to be some sort of quota arrangement restricting the output of individual British electrical firms, the Southern Railway Company has placed the contracts for the rotary converters required for the next stage of its electrification scheme with a Swedish firm. In response to the company's invitation to the three British manufacturers who supplied the previous equipment to quote for twenty-three additional rotaries, two of the firms offered to supply fourteen machines jointly and one of the firms declined to quote at all. Of these fourteen converters the supply of seven was made conditional upon the contractor receiving an order for certain other electrical apparatus, which had formed the subject of a separate inquiry, and for which, in fact, the company had received a more favourable tender from another firm. Subsequently one of the firms that offered to supply fourteen machines agreed to supply the full number required, but only on the condition that the contracts for the additional nine rotaries should be post-dated to next November. Under the circumstances the company felt that it had no alternative but to find a contractor prepared to meet the full requirements on reasonable terms and was reluctantly compelled to turn to a continental firm. The price quoted by that firm was appreciably less than that required by the British firms, but the Southern Railway Company, in an official statement, emphasises the point that it was not the lower price alone which caused it to place the order abroad; it was felt that British enterprises should not be penalised by British manufacturers seeking to dictate terms and conditions. Mr. D. N. Dunlop, of the British Electrical and Allied Manufacturers' Association, has apparently admitted that there was an agreement to divide the business in this country between the manufacturers of this class of machinery. He contends, however, that the railway company could either have placed the order for the supply of the whole of the machines with another British firm outside the three referred to or have divided the order up among other British firms. In view of the fact that the production of rotary converters in this country is greater than the demand in the home market, it is reasonable, in Mr. Dunlop's opinion, that there should be an arrangement by which the business can be divided among the firms in the industry.

The Liner Statendam.

THE Holland-America liner Statendam, which was launched from the East Yard of Harland and Wolff, Ltd., at Belfast, in September, 1924, and has since been laid up, left Belfast last week in the charge of four Dutch tugs for Schiedam, Holland. She will be completed by Wilton's Engineering and Slipway Company, of Rotterdam and Schiedam, and the work, it is anticipated, will occupy about two years, so that the vessel will in all probability be available for the 1929 services of the Holland-America Line. A new company under the title of the Mail Service Holland-America Line has been formed with a registered capital of 40 million guilders to finance the completion of the vessel. It is understood that, although the actual work will be carried out by Wilton's, the co-operation of Harland and Wolff, Ltd., the builders of the ship, has been secured. So far no final decision has, we understand, been reached with regard to the type of propelling machinery which will be installed in the ship. The proposals put forward include, however, we are informed, high-pressure geared turbine machinery with water-tube boilers designed for pressures higher than that, 350 lb., which has been adopted for the new Canadian Pacific liners. It is hoped that Harland and Wolff, Ltd., may participate in the orders for the machinery, which, if placed at Belfast, would in some measure compensate for the loss sustained by that port in the completing of the liner in Holland. The Statendam has an overall length of 697ft., with a breadth of 81ft. and a depth of 53ft. 6in. Her accommodation will be designed to provide for about 3000 passengers, and her measurement will be between 28,000 and 30,000 gross tons.

French Air Services.

THE creation of international air lines is considered in France to be a matter of extreme urgency, particularly the line from Toulouse to Buenos Aires by way of Dakar, Cape Verde Islands, Noronha Island, and Pernambuco. It is feared that if the various schemes now under consideration are much longer delayed the overseas air services will be so far monopolised by foreign companies that there will be very little left for the French to do. The carrying out of some of the schemes has been held up partly by financial considerations and more particularly by the lack of suitable seaplanes of large capacity. The French came late into the field with the designing and construction of seaplanes, and although there have always been some firms specialising in them, no one succeeded in grappling with the problem of building powerful seaplanes with a wide range of action and a sufficient paying load, until it was taken up by the Chantiers de Penhoët. The Richard-Penhoët seaplane is a monoplane of very thick wing section and is propelled by five "Jupiter" engines giving a total of 2100 horse-power. The central engine is in front of the flying boat, well ahead of the others, which are on the edges of the planes. The total width of the machine is 40 m. and the length 27 m. The total weight of nearly 20 tons includes more than 5 tons of fuel necessary for the journey between Cape Verde Islands and Pernambuco and about 1 ton of paying load. The construction of the machine is a combination of wood and metal. The trials carried out in the Bay of Saint-Nazaire for some months past have been promising, showing, as they do, that the huge machine is capable of being handled satisfactorily; but many defects have been revealed which are being remedied, notably in the arrangement of the engines and in strengthening certain parts of the machine that developed signs of weakness. It is mainly upon the success of the Penhoët seaplane that depends the early future of the all-air route to South America. Meanwhile there is believed to be little hope of the international air lines becoming financially successful unless it is possible to encourage home traffic by means of local lines radiating from the big air stations. A beginning has already been made in the northern departments with Lille as a centre, and a meeting was held recently at Bordeaux to decide what should be done for the development of air services in that region. It is proposed to create air lines from Bordeaux to Geneva by way of Lyons; to Nantes, Cherbourg and England, with branches to Havre and the Nord; to Toulouse, Marseilles and Nice and to Poitiers, Tours and Paris. The importance of carrying out this work without delay was embodied in a resolution which also recommended that the general plan should be prepared by the Union des Offices de Transport des Chambres de Commerce with the assistance of the French Air Propaganda Committee, that the creation and working of the lines should be placed in the hands of one body and that the air stations should be under the control and management of the respective Chambers of Commerce. The home air services would thus become a national organisation.

The Modern Steam Engine and Internal Combustion Motors.

By MAURICE DEMOULIN.

No. II.*

IMPROVEMENTS IN THE PRODUCTION AND UTILISATION OF STEAM.

In the evolution of human inventions, it has often happened, after long attempts in another path, that a return is made to the ideas or principles originated by the very first pioneer. The steam engine, during its long career, has not escaped from this law. Denis Papin (1687) is, beyond contest, the first who had the intuition of the motive power that steam could develop by its own pressure and without condensation. But he was before his time, and could not be understood. Besides, he only had at his disposal rudimentary means of achievement and rough contrivances; the engineering industry was not even in its infancy; both makers and materials were deficient. Consequently, later, it was Savery's and Newcomen's atmospheric engine, hopeless as it might be thermodynamically, that was successful, because it answered the first need of motive power—mine pumping—and could be made successfully with the very poor equipment and workmanship of the day. In other words, the idea was practical as it complied with contingencies. Their followers, more or less immediate, and Watt particularly, relied more on the difference of pressure resulting from the vacuum in the condenser than on any initial pressure of steam itself. Watt's capital invention was really the disjunction of the cylinder and the condenser. It was the starting point of the steam engine, properly speaking. Thus the steam engine was possible because it was adapted to the existing state of metallurgy and workmanship. The engine called "high pressure" made its appearance later, when the works were in a position to make boilers capable of standing what was then considered as high pressure. Most of these engines were non-condensing and this allowed the development of the locomotive which, very early, included the principal features of the modern engine. The increase of pressure has everywhere closely followed the progress of equipment and of metallurgical processes.

Nevertheless, condensation was not given up; far from it. It was, on the contrary, completed and perfected, not only for marine engines, but also for all important land plants; the theoretical increase of efficiency thus obtained, much higher, however, than the actual efficiency, amounts to 35 per cent. for a working pressure of 142 lb. (10 kilos.), for example. Indeed, some of the most recent improvements have resided in increasing the vacuum—more perfect air pumps and separate water pumps—and in designing engines able to derive profit from it—such as turbines. The low-pressure cylinder of triple-expansion engines works almost entirely on vacuum, as did the single cylinder of Watt's engines. It can be said that such an engine is the coupling of two high-pressure engines to a low-pressure one; this last not very different in principle from Watt's engines, but in which steam is furnished by the exhaust of the intermediate cylinder.

The turbine, in addition to being able to take advantage of a greater expansion, corresponding to the increase of vacuum, has an advantage perhaps sometimes overlooked, I believe. With an alternating marine triple-expansion engine, it may happen—and I have had myself the occasion of ascertaining the fact—that the engineers in charge, not noticing any escape of steam through the low-pressure stuffing-boxes do not sufficiently tighten the glands, so that air finds its way to the condenser, thus reducing the vacuum or increasing the work of the air pumps. And, what is more, oil used to lubricate the piston-rods follows the same way. It is always possible to detect when an engine is badly taken care of, in this respect; the low-pressure cylinder rods not being as bright as the others, and even sometimes rusted.

As the efficiency of the steam engine could only be improved by the increase of initial temperature—the benefit resulting from expansion being supposed unchanged—the increase of the working pressure has been the uninterrupted preoccupation of engineers, prevailing over the whole history of the steam engine since the time of Newcomen up to the present day, and it has perhaps never been so active as it is now. Beginning with the 30 lb. or 50 lb. used through the 'forties, it has progressively reached 215 lb. for the locomotive or the marine engine—with one notable exception, the King George V., which uses 530 lb.—and for central stations 500 lb. and, exceptionally, 800 lb. Numerous and competent specialists believe a further advance is possible, and in several cases higher pressures are being tried. Such a development is bound up with the progress of metallurgy, of shop equipment, and of the abilities of the makers, all branches of industry being in close dependency upon each other.

To compete with the new motors—and it can do so—the steam engine must go through certain transformations already effected on land, in the great power stations, but to a much smaller extent on board ship, especially in what concerns boilers and reciprocating engines. My intention is to review the directions in which these modifications are to be sought. It is evidently far from my mind to criticise with partiality motors upon which so much ingenuity and tenacity have been expended with success, and which have so rapidly developed for marine service. I simply intend to show and to repeat, if it is really necessary, that the steam engine is far from having said its last word, and that it has recently been the object of very interesting improvements, and is susceptible of receiving more.

High pressures offer this other advantage, that latent heat decreases as pressure rises; for example, it falls from 966 to 779 B.Th.U., as the pressure varies from that of the atmosphere to 500 lb. per square inch. Now, the critical point of steam, *i.e.*, when its latent heat is zero, is in round numbers about 3200 lb. pressure. Hence some inventors have proposed to increase the working pressure up to this figure. The idea is ingenious, but many practical difficulties must be overcome to obtain such a result, as we shall observe later.

Whatever be the importance of increasing the working pressure of steam there is, however, at any given period, a practical limit, say, the weight, if we consider steamers, and for all kind of plants the first cost of installation, which increases with the difficulty of manufacture, and which would present insurmountable obstacles, or at least obstacles quite out of proportion with the benefit to be expected in what concerns fuel consumption.

The curves shown in Fig. 1 (*ante*) represent, in round numbers, the theoretical efficiency of a cycle for pressures varying from 70 lb. to 3200 lb. (225 kilos.), condensing and not condensing. They show that the efficiency increases at first at a quick rate; 35 per cent. when passing from 70 lb. to 500 lb. It then slows rapidly, and from that pressure to 1432 lb., and thence by doubling to 2864 lb., the total gain is only 29 per cent. for an increase of pressure of 82 per cent., with condensation. The gain is only 14 per cent. when the working pressure increases from 1432 lb. to 2864 lb. Would, indeed, such a small increase in theoretical efficiency be worth the great complications and difficulties of manufacture and the excessive rise of first cost which it would involve? Let us take care not to go too far and deprive the steam engine of the features which we have praised, and which many makers and owners still appreciate. Fuel consumption, we cannot repeat too often, is not the only question, important as it is now. There are other questions—good working in all conditions of service, adjustment, maintenance, flexibility, possibility of using any available fuel, and of meeting widely varying demands, first cost and sinking fund, &c.

In large central stations, which represent the most perfect plants as regards thermal efficiency, the pressure of 800 lb. has so far only been exceeded in a few cases. Engineers will probably go a good deal further in the future, but I believe that, for the present time, the practical limit lies between 900 lb. and 1100 lb. for land plants and it seems unlikely that such pressures will be used on board ship, save exceptionally in the near future. These high pressures, when using water-tube boilers, do not appear more exceptional or of more difficult realisation now than the 220 lb., actually reached with ordinary cylindrical or locomotive boilers, seemed on land or at sea in 1840. Higher pressures would involve difficulties of manufacture in water-tube boilers and excessive weight as well as very high cost. It may be doubted if, for the present, the relatively small benefit in coal consumption would be at all in proportion with the first cost. But it is difficult to express, now, a definite opinion when progress is so rapid, and when new steps may always be expected.

The boldest departure in this direction is probably the vertical tube Sulzer boiler operated in the Winterthur works. The working pressure is 1565 lb. and the temperature of steam, after superheating, 707 deg. Fah. This firm, which builds a well-known and excellent two-stroke Diesel motor, acknowledges itself that this steam plant—including high-speed turbines—combines the fuel efficiency of the internal combustion motor with the practical advantages of the steam engine.

The curve of Fig. 2 shows graphically the absolute benefit to be derived from condensation for different pressures, and that it is practically constant, after a certain point has been reached. But the relative gain g decreases rapidly with the initial pressure, as can be inferred *a priori*. If we call U and U^1 the theoretical thermal efficiency with and without condensation respectively, we shall have $g = \frac{U - U^1}{U}$ in round numbers. It can thus be seen at a glance that the benefit due to condensation, nearly 60 per cent. for an initial working pressure of 70 lb., would be about 18 per cent. for a working pressure of 850 lb. For the now usual working pressure of 500 lb., the theoretical gain is 32 per cent. But the real benefit is a good deal lower because of the greater losses by condensation in the cylinders owing to the increased range of temperature, initial and final—unless steam is much superheated—and a slight reduction of mechanical efficiency owing to the power expanded in working the air, water and circulating pumps. There is another difficulty, it is that of increasing expansion without causing undue friction inside the engine itself owing to the use of very large low-pressure cylinders. This difficulty is overcome by the turbine, which must be regarded as the complement of high vacuum. But the real benefit subsisting is, of course, well worth the attention paid to it, and explains the general adoption of condensation as complete as possible.

Cylindrical boilers cannot be used beyond a working pressure of 230 lb., and it cannot really be considered good practice even to use such pressures in shells of such diameters with inside furnaces or combustion chambers, and flat ends. Cylindrical boilers of any type have, for a long time, been given up in large stationary plants, and it is the adoption of water-tube boilers which has enabled further advances to be made, as they include only cylindric elements of small diameter, and subjected to internal pressures.

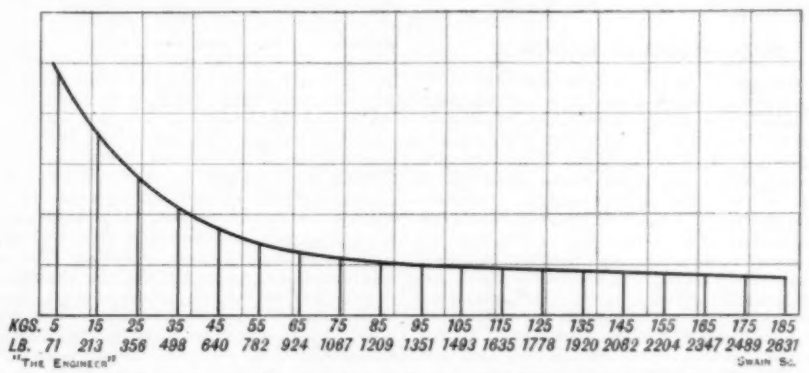


FIG. 2—CURVE SHOWING BENEFIT DERIVED FROM CONDENSATION FOR DIFFERENT PRESSURES

Water-tube boilers of different kinds may, of course, be adapted, by suitable modifications and alterations in their proportions, to stationary or sea service. Certain types are designed in view of more special applications. Boilers such as the Thornycroft, Normand, Yarrow, &c., descendants in a straight line of the primitive Du Temple type, are chiefly used on board warships or liners. Other boilers, such as the Stirling, Ladd, Ladd-Belleville, &c., are used on land and especially in electric stations, whilst other types, such as the Belleville, Babcock and Wilcox, Yarrow, &c., can almost without notable alterations be applied to both kind of service.

The first boilers mentioned are generally more compact and have tubes of smaller diameter than those of the second class; they are designed with very active combustion and circulation in view, and offer the minimum possible weight when compared with the amount of steam generated, especially if oil-fired as they are, as a rule, on fast warships and some passenger steamers or liners. When moderately pushed, they are able to render great services in the mercantile marine.

The Belleville boiler is, without doubt, the pioneer of water-tube boilers on an important scale, and was the first to employ automatic feed regulators; with many improvements, it is still used on board French and foreign ships. It is to be found now on some of the fastest Channel steamers plying between Dieppe and Newhaven.

Amongst other advantages, water-tube boilers readily admit of arrangements for giving the hot gases several passes by means of arches and baffles made of refractory tiles, and they are easily fitted with superheaters and feed-water heaters. They have other and secondary advantages. For example, when auxiliary work in harbour is in hand, if a donkey boiler is not fitted, it is necessary to use a main boiler for deck machinery, heating, and lighting purposes. Water-tube boilers, in such cases, prevent an important loss, for the units are smaller and can be put on or shut off more quickly.

Concerning electric stations, it is to be noted that, not only the size of the plants, but that of the plant units has increased enormously in late years. Two

* No. I. appeared April 15th.

thousand horse-power boilers or even larger are now almost common, and 40,000-kilowatt alternators are no longer exceptional.

Whatever may be the good service obtained from the class of boilers fitted with nearly horizontal or but slightly inclined tubes, it seems that, as more active vaporisation and more complete circulation is needed, the vertical or steeply-inclined tube types will come more and more into favour, and a great impetus has been given during the past few years to their construction, particularly for central stations. Thanks to rational combustion, to superheaters and feed-water heaters, the thermal efficiency of these boilers, particularly for plants of great capacity, is seldom less than 90 per cent., and reaches often 93 and 94 per cent. as I have said, the gases being exhausted at a temperature not exceeding 250 deg. Fah. With the growing scarcity of good coal, at least outside of Great Britain, or its increasing cost, cheaper grades must be burned in most countries, and this fact has rendered even more complex an already difficult problem.

Vertical tube boilers have, in the case just considered, another advantage, and really a very important one, in that they allow us to obtain large heating surfaces for every square foot of their horizontal projection, *i.e.*, to realise precisely the large units just mentioned, in consequence of the use of mechanical stokers and of oil or pulverised fuel.

To increase the heating surface of a horizontal tube boiler[2] we have three means at our disposal :—

(*a*) *Increase of the Number of Tubes in Each Vertical Row.*—This is only practicable within narrow limits because these tubes, opening into drums of a very moderate diameter, their number cannot be extended without imperilling the repartition of the circulation in the whole nest of tubes.

(*b*) *Increase of the Length of Tubes.*—More limited yet, the flow of the steam generated not being satisfactory after a certain length has been passed.

(*c*) *Increase of the Number of Rows.*—This leads to increase of the width of the boiler and its horizontal bulk, which is contrary to the purpose desired.

With vertical tubes, on the contrary, the increase of heating surface may be made in all directions. No inconvenience arises from increasing the number of tubes, since they are connected into large diameter drums, in which circulation is not disturbed. There is no limitation to the length of the tubes, the circulation being made easy, thanks to the vertical or very steep position. It is therefore no exaggeration to assert that horizontal tube boilers, very well adapted to moderate powers, are not so for the constitution of the very large units of 20,000 square feet and even more, now needed for large central stations.

But, even in vertical tube boilers, the number of units must be sufficient to comply with the variations of the output, from the easy to the peak hours.

The thermal efficiency of a boiler plant depends, as is well known, upon two principal elements—(*a*) more or less perfect combustion which depends upon the efficiency of the fuel itself ; (*b*) capacity of the boiler to absorb the heat resulting from the combustion.

The general development, in all electric stations of any importance, of mechanical stokers—chain grate, underfeed, &c.—was first and foremost intended to reduce the cost of labour for attention and firing, as well as to regulate the rate of combustion in an effective manner and to proportion it to the rate of energy to be produced, to meet varying demands. But it had immediately—and this result was soon improved by means of different devices, such as suspension arches—a not less important result in the production of methodical combustion, much more rational and complete, and by the abatement of smoke. By reason of the method adopted, the fresh coal, when automatic stokers are in use, is delivered at the less heated region and the hydro-carbons are distilled under the action of radiation, and, finding the necessary amount of air, are soon ignited and burn, together with the CO, with long flames throughout almost the whole length of the furnace. As the grate advances, the ignited coal is more and more deprived of gas, and finally contains nothing but carbon and ashes. When it arrives at the far end of the grate, all the proper fuel is burned, and there are only left clinkers and ashes, which automatically overturn in the ashpit and are, later, conveyed outside.

With well-operated mechanical stokers, the combustion is complete, and not only for the reasons just explained, but also because of the brick arches of different systems—most of them of the suspension type—placed over the grates at a convenient height, the furnace being thus converted into a kind of gas producer. The combustion is much improved by the radiation from the red hot arch on to the fuel and gases. Air inlets are arranged where necessary.

Yet these stokers are not without some d awbacks, especially as their maintenance is fairly costly, and because of casual difficulties in regulating exactly the speed according to the draught or to the various grades of fuel, so that the operations described above may be conducted in good order and with sufficient precision. Within the past few years, these systems have met with a competitor in the form of pulverised coal, which is generally successful if the plant is well designed, proportioned and regulated. Its principal advantage is that it enables low-grade fuel with a high percentage of ash—up to 20 per cent. sometimes—to be burnt. It also readily adapts itself to varying or various grades of fuel, and is easy to regulate. This system has been employed on a large scale, principally in America and in France. Some very important applications are in operation in central stations in the outskirts of Paris, one of them, at least, probably the largest in the world. The combustion of powdered coal is effected by means of special burners, such as the Lopulco system. The burning gases are at first directed towards the lower part of the combustion chamber, and the flames, drawn by the draught, turn back upon themselves and pass through the nest of tubes. The greater part of the ashes and clinkers form a very fine dust, which, by difference of density and cooled by a row of horizontal water tubes, disposed above the ashpit and connected to the boiler—water screen—fall into these pits. But this dust on account of its fineness is not easily handled, and cannot be used as ordinary clinkers are for the manufacture of artificial bricks, for example.

In all these different systems, the combustion chambers are of very large size, and have a considerable depth, sometimes two-thirds of the total height of the boilers—an excellent condition, when the air inlets are properly disposed to ensure complete combustion. With powdered coal burners, the lower drums of the boilers are placed on top of the combustion chamber, nearly at the point where the flames cease.

The use of pulverised coal is, of course, more advantageous in countries having a shortage of high-grade fuel. Great Britain, so well favoured in this respect, is probably the land where it can be considered as the least necessary, but it may be useful when economy is sought by the use of low-grade fuels.

Whilst we are on this subject, let us remark that the use of water power, with which some countries, such as France, Switzerland and Italy, are particularly favoured, is often very expensive in first cost —captation, dams, works, distribution, &c.—and involve considerable sinking funds. For the user, it is very economical in the long run, and gives complete independence, being safe from any shortage of coal, strikes, or foreign importation of fuel. The maintenance costs are relatively low.

(To be continued.)

[2] I adopt the usual denomination : horizontal tubes, those really horizontal or having an inclination under about 40 deg., and vertical tubes, those making an angle of more than 40 deg. with the horizontal or absolutely vertical.

A New Method of Making Beet Sugar.

For some time now the Institute of Agricultural Engineering, University of Oxford, has been carrying out for the Ministry of Agriculture and Fisheries some investigations with regard to sugar beet. The research was the outcome of a report made by a technical commission, composed of Mr. John Bowden, M. Inst. C.E., M.I. Mech. E., late Chief Superintendent at Woolwich Arsenal ; Dr. William Goodwin, advisory chemist at the South-Eastern Agricultural College at Wye ; and Dr. B. J. Owen, director of the Institute of Agricultural Engineering at Oxford, which visited Italy in the winter of 1924–25 to inquire on behalf of the Ministry into the working of the De Vecchis process of beet sugar manufacture. The conclusions arrived at by that Commission may be briefly put as follows :—(*a*) That while the De Vecchis process was sound in principle, the whole question of its practical application was open ; and (*b*) that it—the Commission—considered it advisable to carry out further experimental work in connection with the system in this country. It was therefore recommended that a plant—small, but on a factory basis—should be erected in England in order to test the system experimentally. Subsequently to the publication of the report, a company—Home and Colonial Investments Ltd.—in which Sir Charles Cottier was interested, acquired the patents governing the De Vecchis process in all countries save Italy, and presented the British rights to the Minister of Agriculture and Fisheries. Attached to the gift was a stipulation that the Ministry should arrange for experimental work on the process to be carried out by the Institute of Agricultural Engineering at Oxford.

Now, although the factories in Italy equipped for operating on the De Vecchis system, which were examined by the Commission, had undoubtedly produced sugar, they were not, by reason of frequent breakdowns of the drying plant, capable of continuous working. In fact, at that time, the desiccation of beet had not been effected on a practical scale with any substantial measure of success by the De Vecchis process or by any other of the various methods which had been previously suggested. There were, moreover, other points which seemed to the Commission to need improvement, and it was for those and other reasons that it was considered essential that further researches were necessary before any steps towards applying the process commercially in this country were taken.

As is well known, a considerable amount of successful work on the dehydration of vegetable materials had, before that time, been done by the Institute. It had, in fact, obtained information which, it was thought, might be used as a means of effecting improvements in the technical working of the De Vecchis process, particularly as regards its adaptation to small-scale operations. The Ministry, therefore, decided that a scheme of research to cover a period of two years should be formulated on the lines of the recommendations made by the Commission, and to make a grant which might enable work to be begun in October, 1925.

The Institute got to work with commendable celerity. It immediately started research on a laboratory scale at its building in St. Giles, Oxford, and it acquired a site of about 3 acres in extent at Eynsham, which is some 6 miles from Oxford and quite near a large extent of country suitable for the growing of sugar beet. There, a beet sugar factory on a small, but eminently practical, scale was erected, and in it discoveries were made which promise to have a far-reaching effect on the beet sugar industry.

By the courtesy of Dr. Owen, we were recently given an opportunity of making a thorough inspection of this factory and of learning what had been done in it, and we propose in what follows to lay the result of our observations before our readers. Before going on to discuss the factory and the discoveries made in it, it would be well, however, to refer briefly to desiccation proposals, and to compare them with the ordinary method by which beet sugar is manufactured. In both cases the fresh beets after thorough cleaning are cut into slices, but whereas in the ordinary or diffusion process the slices are immediately passed on to diffusion vessels, through which warm water is passed, so that the sugar is removed by osmosis, in the desiccation system the beet slices are dried, so as to leave only a small percentage of their moisture.

The De Vecchis system of drying, it may here be explained, is divided into two distinct stages. In the first, which lasts one hour and forty minutes, the bulk of the moisture is removed. In the second stage the drying is continued for a further two hours at a rather lower temperature than in the first stage. The object of this additional drying is, according to Dr. De Vecchis, to coagulate the albuminoids and render them insoluble, to rupture the walls of the cells and to sterilise the cossettes. The total drying period lasts, it will be noted, for three hours and forty minutes.

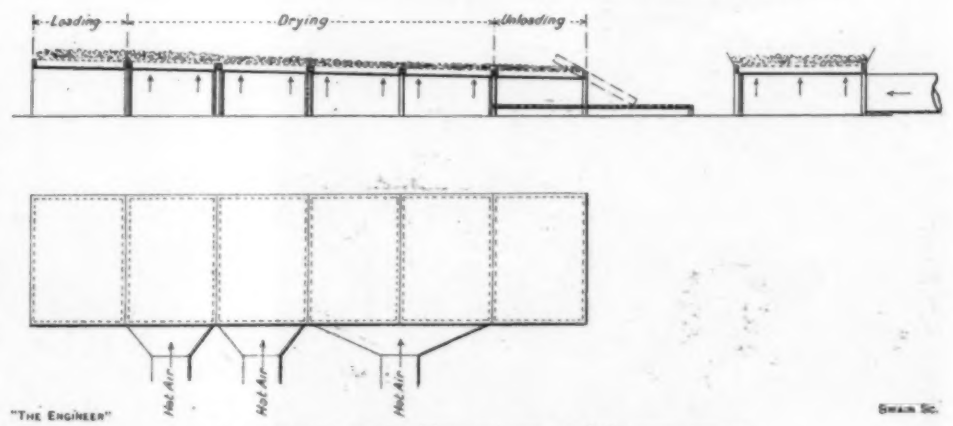


FIG. 1—DIAGRAMMATIC SKETCH OF THE OXFORD BEET DRYER

The dried De Vecchis cossettes are placed in a series of lixiviation vessels through which warm water is passed. As a result, a thick syrup containing some 50 per cent. of sugar is produced. The juice is then purified, or defecated, as it is called, first with lime and later with calcium superphosphate, and subsequently passed through filter presses.

The thin juice delivered from the diffusers in the ordinary process—which may contain some 16 per cent. of sugar—is, on the other hand, first of all defecated with lime, and subsequently with carbonic

acid, and is afterwards passed through filter presses to remove the precipitated calcium carbonate and other impurities in suspension. It is then concentrated in multiple effect evaporating apparatus until it becomes a thick juice.

Thereafter the procedure is the same in both processes. The thick juice is boiled in vacuum pans until crystallisation of the sugar commences, after which the boiled mass is cooled and stirred to increase the size of the crystals, and the crystals of the raw sugar are separated from the molasses by centrifugal machines.

The results obtained at Oxford and Eynsham have more than come up to expectations. The experience gained during the work in the laboratory at Oxford was sufficiently definite to indicate clearly the type of plant which would be required at Eynsham. At the latter place three buildings were erected, one for the treatment of the beet, another containing a laboratory for chemical research and routine analysis, and the third for an engineering shop and stores. The machinery provided included a small steam engine driving a dynamo, a boiler, a beet slicer capable of dealing with 5 tons of beet per hour, an experimental lixiviation battery with a capacity of 1 cwt. of dried cossettes per hour, defecating tanks, a filter press capable of treating 60 gallons per hour, a vacuum pan and pumps, crystallisers, a centrifugal, &c.

At the outset a dryer constructed on the same general lines as that of Dr. De Vecchis was built and experimented with. The De Vecchis dryer, it may be explained, consists of six horizontal travelling belts made of a mesh material to permit of the passage through them of air, and arranged one over the other, three above and three below a horizontal division. Currents of heated air are passed downwards through the three top belts and upwards through the three lower belts. The wet slices of beet are fed on to one end of the topmost belt and are carried along to the far end of it—a process which takes twenty minutes—and then fall on to the second belt, travel to the far end of it, and fall on to the third belt ; and so on till they are discharged from the sixth belt. The five lower belts each travel their length in forty minutes, so that the total time taken for the cossettes to travel through the dryer is three hours forty minutes. The air temperatures in the neighbourhood of the various belts are, counting from the top, 130 deg., 120 deg., 110 deg., 70 deg., 80 deg., and 90 deg. Cent. Although the dryer built at Eynsham followed, as said above, the same general lines as the original De Vecchis machine, it was so designed that the temperatures and the time of drying for the whole process, and also the time and temperatures of the different stages of drying, could be varied as desired. By making certain further alterations, various faults which the Commission had noted in the De Vecchis apparatus were also eliminated.

As the result of the modifications made and of using slices of a smaller size than, and of a shape different from that of those used by De Vecchis it was found possible to dry the cossettes satisfactorily in less than one hour instead of the three hours and forty minutes of his process. This very considerable reduction in time has been made without any deleterious effect. With the cossettes dried by the Oxford method, the extraction of the sugar is as good as with those dried in a longer period, and the result is obtained without decreasing the efficiency of the dryer. In fact, the sugar juice is said to possess a higher degree of purity and concentration than any raw juices obtained before the introduction of this method of drying. It was found, too, that continuous and satisfactory drying could be carried on for an indefinite time without any of the breakdowns experienced with the De Vecchis equipment.

The second stage of the Italian drying was most carefully examined and found to be quite unnecessary. Investigation showed that the cellular walls were not ruptured, and that prolonged heat treatment was not essential for bringing about coagulation of the albuminoids. From the first of these discoveries it follows that, strictly speaking, the sugar is extracted from the dried cossettes, not by lixiviation, but by simple diffusion as in the ordinary process.

The practical requirement in the drying of beet is that a quantity of water amounting to, approximately, 75 per cent. of the total weight must be removed—that is to say, reducing the moisture content to about 5 per cent. It was found at Eynsham that it was essential to remove that moisture quickly so that the material should not be heated in a moist state for any appreciable length of time. The chief deleterious effects that are likely to occur when drying beet by the aid of heat are caramelisation and inversion of the sucrose. Caramelisation occurs at definite temperatures varying with the amount of moisture present, and is essentially a destruction of the sugar. Although it may not cause a large direct loss of sugar, caramel has pronounced colouring properties, which result in difficulties in the after treatment of the juice. Inversion is a hydrolising action that transforms sucrose into what is known as invert sugar, which is a non-crystallisable substance, so that when inversion takes place there is a direct loss in the amount of sugar produced.

In the Oxford process, caramelisation is entirely avoided and the quantity of invert sugar produced is negligible. It was found that, so long as the temperature to which dried or partially dried cossettes were exposed did not exceed 110 deg. Cent. (230 deg. Fah.), no formation of invert sugar or caramel occurred. It was found, too, that the best results were obtained when the drying was effected in one hour or less.

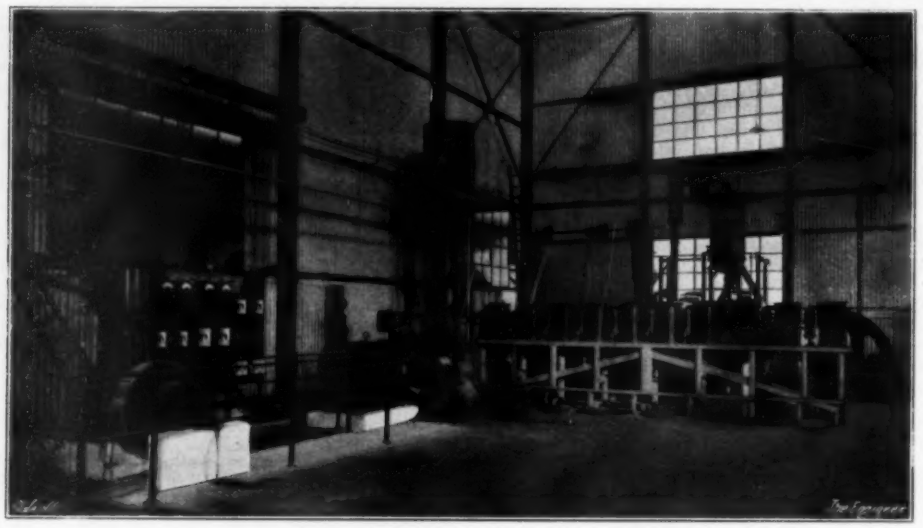


FIG. 2—EXPERIMENTAL SUGAR EXTRACTION PLANT AT EYNSHAM

FIG. 3—A CORNER OF THE EYNSHAM SUGAR FACTORY

FIG. 4—PART OF LABORATORY, SHOWING SACCHAROMETER

From the first the Institute employed, for heating and propelling the air necessary for drying, the same type of apparatus which it devised for the artificial drying of crops, and which was described in our issue of October 17th, 1924. Briefly, that apparatus consists of a combustion chamber into which are projected the flames from oil burners, and round the outside of which is drawn by a fan the air that it is desired to heat. The fan also serves to propel the air under pressure to the dryer. But little alteration to this apparatus was, we believe, necessary to adapt

it for operating in connection with beet dryers. Other forms of dryer, in addition to the modified De Vecchis machine already alluded to were tried. Among them was an apparatus designed very much on the same lines as that used for drying stacks. The wet beet slices were piled round a vertical cylindrical chamber furnished with perforated sides, so arranged that heated air could be forced into it and find its escape to the atmosphere between the cossettes. As at first employed, this arrangement was found to operate successfully and possessed definite advantages, but it was only suitable for dealing with small quantities at a time. The experiments indicated that some form of mass drying could be used on a larger scale for factory purposes. Another form of dryer evolved by the Institute comprised three horizontal travelling belts, as compared with the six belts of the original De Vecchis machine. In this dryer there was provision for reheating the air after it had passed upwards through two of the belts and before the third belt —that is, that on to which the wet cossettes were fed —was reached.

Still another type was worked out. It consists of a series of rectangular trays, arranged horizontally, end to end, and having wire mesh bottoms, and at the time of our visit, we saw it in full operation. Several views of it are given on page 442, and we can say at once that it was performing its duty extremely well. The beets to be dried were being taken from silos where they had been stored to protect them from the frost. They were being washed in the horizontal revolving cage formed of steel bars that is seen in Fig. 8, page 442, the lower half of which is in a tank of water, and which is revolved by the electric motor on the right-hand side. The dirty roots are fed into the cage at the left-hand end, and come out cleaned at the right-hand end. Close by the washer—immediately behind it in the engraving—is a Maguin beet slicer, the belt-pulley driving which can be seen in the background of the engraving, and the top of which is visible at the extreme left hand in Fig. 9. The slicer is furnished with Faitière—ridge-tile—knives that produce slices like V-shaped troughs, which have been found to be much more satisfactory than the rectangular slices cut by Napravil knives that were used for the De Vecchis process in Italy. The slices as they come from the machine are, as an average, somewhere about 3in. long and rather under ¼in. between the tops of the sides forming the V. They are shovelled by hand and spread on the first horizontal tray of the dryer to a depth of some 10in., as may be seen in Fig. 9. The dryer comprises four trays, each measuring some 8ft. by 6ft. On the first are spread the slices which are about to be dried, the next three come over three separate chambers into which heated air is blown by means of the equipments for crop drying referred to above. In Fig. 9 can be seen one of these equipments with the hot air duct running into the chamber at ground level. The temperature in the three chambers can be varied as desired, but generally it is from 220 deg. to 230 deg. Fah. in the first, or that immediately under the wet cossettes; from 200 deg. Fah. to 210 deg. Fah. under the second; and from 190 deg. Fah. to 200 deg. Fah. under the third. These temperatures, which can be controlled at will, can be read by an indicating dial thermometer that can be made to show instantly the temperature of any one of the chambers as desired. The trays are connected to one another temporarily, so that when that at the far end is hauled by the winch seen in Figs. 10 and 11 all of them are moved away from the feeding end. They rest on rollers and are given a slope to facilitate this process, and the arrangement is such that, when the drying of the cossettes on the tray furthest from the charging end is completed, chains are hitched on to two eyes arranged at the end of the tray and the latter is drawn forward sufficiently to bring the tray next to it into exactly the same position that it has vacated. The couplings are then undone and the tray may be tilted down as seen in Fig. 11, so that the dried cossettes may be shovelled into sacks or dealt with in any other suitable manner. The trays over the first two chambers are open to the air, so that the moisture-laden air is readily discharged into the atmosphere. The third and last tray is, however, covered in. The general principle of this type of dryer, which is found to operate exceedingly well, is shown diagrammatically in Fig. 1. It will be noticed, however, that four and

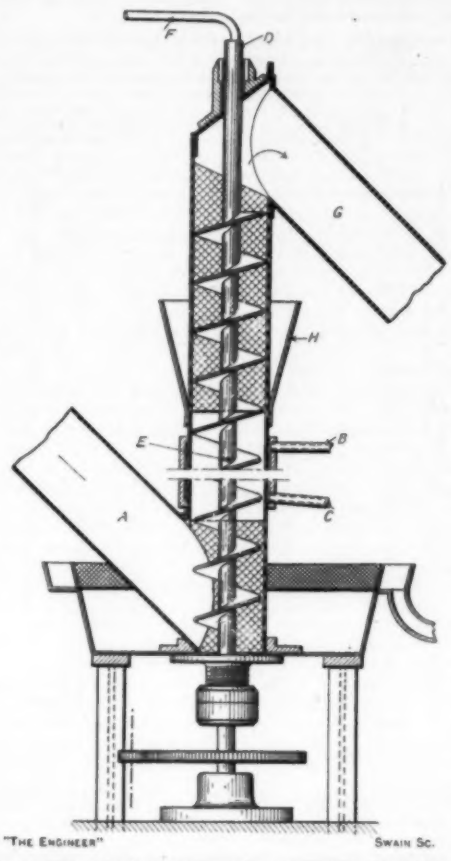


FIG. 5—THE OXFORD CONTINUOUS DIFFUSER EXTRACTOR

not three hot air chambers are shown. This change from three to four trays the Institute, as the result of its experience with the existing plant, considers to be an improvement.

As compared with all the other forms of apparatus hitherto used or contemplated, the process governing the drying is one which is altogether new and is claimed to have solved the problem of the desiccation of beet. It is known as "mass drying." The principle underlying "mass drying" is the removal of water by drying the material in a heavy layer or mass which has consolidated owing to its initial inherent weight. The character of the air conveyed to the mass is carefully determined in order to procure:—

(1) The natural exudation of water due to weight;

(2) the greatest quantity of water taken away by the carrying property of the heated air; and

(3) The natural heat reaction which takes place within the vegetable material when heated.

The natural heat reaction is known as an exothermic effect. It can only be produced by a proper balance of the quantity of air, the precise temperature, and the thickness of the mass of beet. These factors are exactly determined to produce the exothermic change, which change has the advantage of removing a greater quantity of water than is possible by the mere carrying power of the heated air. In fact, it increases it by about 20 per cent., with the still more important effect of producing a slight organic change within the material which prevents the inversion of the sugar. This method, according to the University staff, results in effective drying, is the only way in which beet can be properly dried, and represents an entirely new principle in drying material of an organic character such as beet.*

At the present time the hygroscopic power of the dried cossettes and its effect upon sugar content and subsequent extraction are being studied. So far as has been ascertained up till now it is not necessary to reduce the moisture content below 7½ per cent. in order to ensure sound keeping qualities, though, actually, as explained above, the moisture content is in practice reduced to 5 per cent. The dried cossettes absorb moisture to a small extent on keeping, but not enough, so we gather, to produce any deleterious result. Since it started to work, the small factory at Eynsham has satisfactorily dried 1000 tons of beet. We saw a great store of the dried material in sacks, and we were informed that, not only had some of it been dried for twelve months, but also that it yielded just as much sugar on treatment and was still in as perfect condition as were the newly dried cossettes. One great advantage of the successful drying of beet is, therefore, that a beet sugar factory need not now only work for the hundred days or so of the "campaign" and remain inactive for the remainder of the year, but can spread its operations over the whole year. For a given yearly output, therefore, the factory treating dried beet may be considerably smaller than a factory working on the ordinary diffusion process.

That, however, is only one advantage. There are others. It may, at first sight, appear to be an anomaly that there should be any advantage in first drying the beet and then immediately treating it with water in order to extract its sugar. As a matter of fact, one great advantage is that such a thick juice—that is to say, that a juice containing such a high percentage of sugar—is obtained that one process in the manufacture of the sugar can be eliminated. The juice as it comes from the extraction vessels approaches in concentration the juice—in the diffusion process—as it comes from the evaporators. Generally speaking, the thin juice from the filter presses in a diffusion factory is concentrated in multiple effect evaporators to about 60 deg. Brix. The juice in the desiccation process is already at 50 deg. Brix. and may even be denser, so that multiple effect evaporators are dispensed with, the juice, after purification, going direct to the graining pans. As the evaporation of the thin juice requires one-third of the total steam consumed in the whole diffusion process, it will be readily understood that there is, with the desiccation process, a considerable saving in that direction, though, actually, rather more coal is required in the desiccation process than in the diffusion process, but the additional cost is more than offset in other ways. For example, the evaporators with the necessary vacuum pumps and condensers are amongst the most costly items in a diffusion factory and need careful supervision.

Another claim made for the desiccation system as compared with the diffusion method is that with it the process of purification is much simpler. The juice is first treated with lime and the excess of that substance is subsequently neutralised with calcium superphosphate, which is the reverse of the treatment as proposed by De Vecchis. The whole operation is performed in one tank and only one filtration is required. At first, some difficulty was experienced

FIG. 6—THE LABORATORY

FIG. 7—THE ENGINEERING WORKSHOP

* See *Bulletin* No. 2. Preliminary Report of an Investigation into the Artificial Drying of Crops in the Stack. Oxford: The Clarendon Press. 1926.

with the filtration of the thick juice, but it was found that a short treatment in a centrifugal removed such a large percentage of the suspended bodies that filtration was rendered perfectly easy. In the diffusion process the juice coming from the diffusers is heated and then has lime added to it. A proportion of the lime is then precipitated by means of carbonic acid and the juice is filtered. It is then subjected to a second carbonitation and again filtered. The process entails the employment of a considerable amount of labour and plant, as, in addition to two sets of mixing and carbonation tanks and filter presses, other plant consisting of lime kilns, carbon dioxide pumps, &c., is needed.

As the subsequent operations of manufacture are the same in case of both the desiccation and diffusion process, there is no need to continue the comparison between them.

The portion of the factory in which the experimental manufacture of sugar from the dried beet was carried out is shown in Figs. 2 and 3. It does not require much explanation, saving to say that it very largely resembles, in miniature, an ordinary beet sugar factory. In the first instance, the cossettes were treated in a row of ten lixiviation vessels, seen in Fig. 2, which gave some excellent results. Later, however, the Institute devised the continuous diffuser extractor, shown in Fig. 5, which superseded the lixiviation vessels. It is an ingenious but quite simple contrivance. It consists essentially of a vertical cylinder, the sides of the upper and lower portions of which are perforated so as to permit of the escape of the juices and surplus water. The cossettes are fed into the cylinder down the chute A and are caught by the vertical revolving screw conveyor, which gradually raises them to the top of the cylinder, since its diameter is only just less than that of the inside of the cylinder. Just above where the chute A enters the cylinder, the latter is furnished with an encircling jacket, by means of which steam or other suitable heating medium can be supplied through the pipe B, the condensate draining away by the pipe C. The screw conveyor or helical worm is mounted on and revolves with the shaft D, the top portion of which is a hollow tube, and in which there are perforations at the level indicated by E, which perforations are in communication with the hollow shaft, so that water entering through the pipe F is directed among the cossettes in the region which is warmed by the jacket. The spent cossettes are discharged down the chute G. Any surplus moisture clinging to them finds its way through the perforations in the upper part of the cylinder into the gutter H, from which it may be led away to the source of water supply, and fed again into the cylinder. The cylinder or extraction tube is mounted in a tank H, into which the juice runs from the cylinder. The upper edge of this tank has an annular strainer through which the juice overflows into a gutter and is led away for further treatment. This apparatus and other parts of the machinery and devices employed in the factory have, we are given to understand, been patented.

An article describing the factory would be incomplete without mention of the laboratory for chemical analysis of the raw and finished products which has been provided, and is in every way well equipped. Nor must we omit to refer to the well-arranged engineering shop. Views of both these departments are given in Figs. 4 and 6 and 7.

The Institute has gone very carefully into the cost of installing and operating a factory operating on the desiccation system, and has come to the conclusion that the unit cost of a factory with a drying and extraction plant sufficient for treating 25,000 tons of fresh beet per year would amount to £2 8s. per ton of beet; or, in other words, that a 25,000-ton factory should cost £60,000. For a 100,000-ton factory it estimates the unit cost at £1 15s. per ton, or £175,000 for the whole factory. As to cost of production, it estimates, and we are assured that its figures are on a very liberal basis, that in a 25,000-ton factory equipped for drying and extraction, the working cost, including all overhead and standing charges—but excluding the cost of the beet—would not exceed 19s. 3d. per ton of fresh beet treated. For a 100,000-ton factory the cost is estimated to be not more than 15s. 2d. per ton of fresh beet treated. At an average abstraction of 13·25 per cent. of sugar—and again omitting the cost of the fresh beet—it calculates that 1 ton of sugar could be produced for about £7 5s. and £5 14s. 5d. in the two sized factories respectively. Considerable improvement in the efficiency of labour and staff, which cannot well be expressed in figures, but which would tend to decrease these figures, would, it is anticipated, result from their continuous employment.

In conclusion, we desire to tender our thanks to Dr. Owen for permission to inspect this interesting factory, and to him and to the various members of his staff with whom we have come into contact for the assistance which they have afforded us during the preparation of this article.

The Fushun Colliery Company has prepared plans for a large plant for distilling South Manchurian oil shale. There are to be forty-eight stills, each with a capacity of 40 tons. It is said, however, that a yield of oil of only 3½ per cent. of the weight of the shale can be relied upon.

Institution of Naval Architects.

No. III.*

The members reassembled at the Society of Arts on the morning of Friday, April 8th, the Duke of Northumberland again taking the chair. After the names of some 121 new and transferred members, associates and students had been announced, a paper on "Propulsion of Ships under Different Weather Conditions," was read by Mr. J. L. Kent. The following is a summary of it.

WEATHER AND THE PROPULSION OF SHIPS.

This paper contains an account of the propulsion and other ship data which were collected by the author during two ocean voyages made during the first three months of 1926, between Liverpool and Havana, in the steamships Oroya and Oropesa, passenger vessels belonging to the Pacific Steam Navigation Company. The voyages were taken with the object of securing

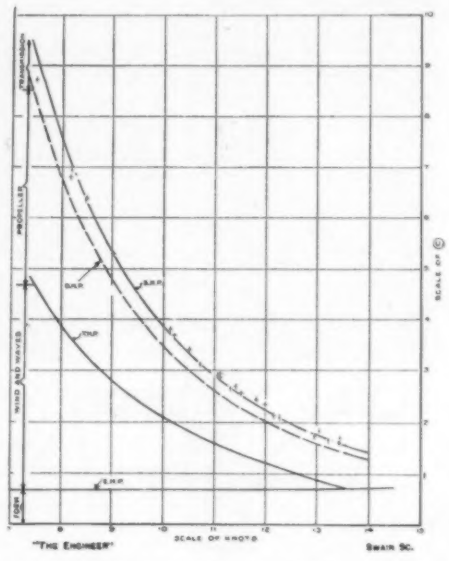


FIG. 1—SPEED AND POWER CURVES, S.S. OROYA

further facts regarding the behaviour and propulsive qualities of ships of finer form than the four already dealt with in the author's earlier paper, which was read at the 1924 spring meetings of the Institution.

At regular intervals during the daylight hours, observations were made of the wind speeds, wave dimensions, ship's speed, power and behaviour, in the manner described in the previous paper. Head wind speeds of from 6 knots to a maximum of 61 knots were recorded in the Oroya on the outward voyage, whilst a maximum wind speed of approximately 90 knots was reached in the Oropesa during the homeward run. As regards the wave dimensions, swells in which the individual waves rose to between 30ft. and 40ft. in height were encountered once by the Oropesa and on two occasions by the Oroya. Fine weather,

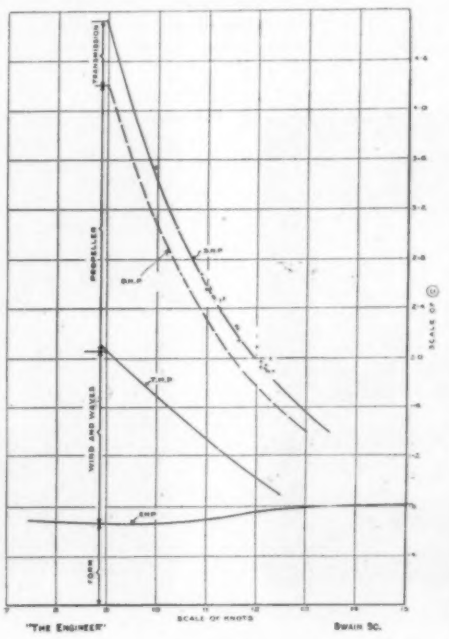


FIG. 2—SPEED AND POWER CURVES, S.S. OROPESA

defined as weather during which the waves were 3ft. or less in height, occurred during two observations only on each ship. The maximum wave-length measured was 900ft. on the outward voyage and 760ft. on the homeward run. The principal noticeable difference between the weather encountered on these trips, as compared with those undertaken in 1922 and 1923, was the greater slope of the waves during the most violent storms, and the comparative suddenness with which these storms reached their height and died away.

Both ships had a length between perpendiculars of 530ft., with a breadth moulded of 62ft. 6in. for the Oroya and 66ft. for the Oropesa. The first named ship was equipped with twin-screw steam turbines with single reduction gearing, and the second ship with the same type of machinery but with double reduction gearing. The mean displacements on the voyage were for the Oroya 13,500 tons, with a mean S.H.P. of 5130, and 23,000 tons for the Oropesa with 6430 mean S.H.P. The shaft horse-powers were determined from Hopkinson-Thring torsion meters fitted on each of the shafts of the Oroya and from Gibson-Bevis torsion meters with which the shafts of the Oropesa were equipped. Fine weather propulsion data is given for both ships, which was derived from observations taken during periods when the waves were less than 4ft. in height and steam trial data. In the case of the Oropesa the actual thrusts obtained on the steam trials were measured and are given. In Figs. 1 and 2 the powers and speed obtained in rough weather are plotted to a base of ship's speed. S.H.P. is the power measured by the torsion meter; D.H.P. is the power delivered to the propellers; T.H.P. the power calculated from the thrust of the screws; and the points marked + are the actual ratios of S.H.P./displacement, which equal approximately 0·38 for the Oroya—Fig. 1—and 0·28 for the Oropesa—Fig. 2. In Figs. 3 and 4 the approximate screw thrusts calculated from steam trial and observation data are given for the mean displacements and mean shaft horse-powers before mentioned. They show clearly the approximate limits for ship

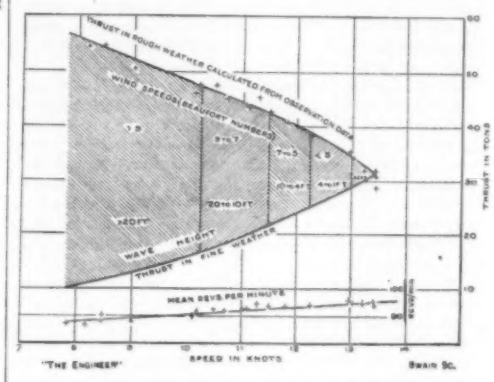


FIG. 3—PROPELLER THRUSTS, S.S. OROYA

speed under various weather conditions, and bring out the large increase in ship resistance which is occasioned by comparatively small waves and wind speeds.

As regards the relative importance of giving weight to the ship's performance in waves, when considering the question of form during the design stage of a projected new vessel it is noted that waves of less than 3ft. in height were encountered during only 8 per cent. of the total time taken by the Oroya to cross the Atlantic and 12 per cent. of the days taken by the Oropesa on the same route.

It would appear from the voyages which the author has made on the North Atlantic during the months of January to April in the years 1922, 1923, and 1926, there is a strong probability that for at least 80 per cent. of the time on voyage during the worst winter months, waves greater than 3ft. high, with winds of greater speed than 15 knots, will be the normal weather conditions.

In the remaining parts of the paper the periodic fluctuation of torque in the propeller shafts is discussed and the probable loss of efficiency due to shaft webs is analysed, the results of observations on propeller race spirals, erosion of propeller blades, and the run of the shaft webs being given. The rolling and pitching of

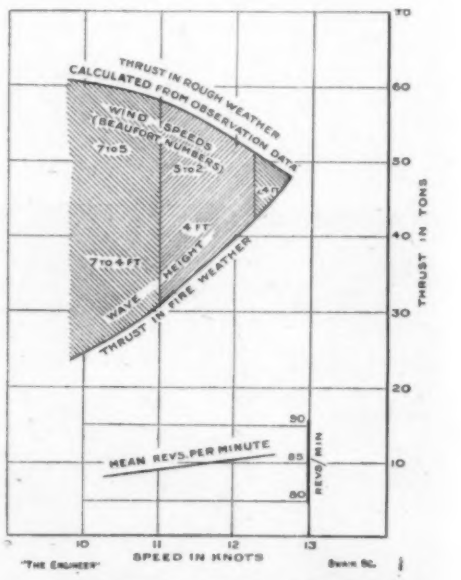


FIG. 4—PROPELLER THRUSTS, S.S. OROPESA

the ships is next dealt with, and the behaviour of the two vessels in this respect is compared. Some notes are given on "pounding" and slamming, and finally the effect of weather on the steering of the ships is discussed.

Dr. E. V. Telfer considered that Mr. Kent's actual observations were beyond criticism, but he directed a little criticism to the routine analyses. He pointed out that, in the table giving the propulsion data in fine weather for the Oropesa, the screw efficiency at 15 knots was shown to be 0·631, while at 7·39 knots it was 0·429, and that appeared to give the first clue to a serious error in the torsion meter readings. It was almost impossible, he suggested, to get that reduction in propeller efficiency when, at the same time, there was a reduction in apparent slip. The initial setting of the torsion meter was a most delicate matter, and his view was that the torsion meter zeros were not correct.

Mr. Hamilton Gibson, pointing to a statement in the paper that in the Oropesa the thrust on each shaft

* No. II. appeared April 15th.

was measured during the steam trials, asked whether thrust meters were used, because recent developments seemed to him to have shown that thrust meter records were more reliable than torsion meter records. The torsion meter was a very delicate instrument. The amount of movement that one had to play with from zero to full power was extremely small, especially when there was a very short length of shaft, and it was quite easy to get a considerable error if the zeros were not correct to start with. He had personal knowledge of the fact that nine or ten years ago, when the Oropesa was new, the zeros were carefully taken, but, if they had not been checked since then, it was time they were.

Mr. J. Tutin, who referred to the problem put forward as being essentially one of accounting for the abnormal propeller efficiency of the full-size propeller, as compared with the efficiency of the model propeller at the same slip, pointed out that the author had dismissed the possibility of torsional inaccuracies, as well as the possibility of the discrepancy being due to an under-estimation of the E.H.P. Reference had been made to the propeller race spirals, but, of course, the race spirals could not account directly for the loss of efficiency, though they might indicate some phenomenon which did account for it. Again, propeller blade erosion could not, *per se*, account directly for any loss in propeller efficiency, but might indicate a phenomenon which did account for it. One of the shaft webs might have a serious effect, of course, and that could be tested directly by a model in the tank.

Discussing the author's reference to erosion on the backs of the propeller blades, Mr. Tutin said that it seemed reasonable to suppose that, if cavities were occurring on the blades, there was no reason why they should not occur equally well on the face as on the back. The author had regarded it as improbable that there was cavitation as generally understood. If pitting were due to the formation of cavities on the back of the blades—which was cavitation as ordinarily understood—it was easy to see why there was no pitting on the face, and in his view the pitting on the back of the blade indicated that there must be cavitation as ordinarily understood. That view was endorsed by an investigation he had made recently into the phenomenon of cavitation, which showed that, for full-size propellers at anything above the very lowest speeds, there was likely to be cavitation at certain sections of the blade. It could be calculated at what speeds and revolutions cavitation on the back of the blade would be incipient. There was a certain pressure distribution for any particular blade section, and, by a fairly direct and fundamental process, one could calculate at what speed and revolutions the absolute pressure at any point would be zero. Any increase in revolutions beyond that would not increase the thrust of that particular portion of the blade section, and therefore, for all revolutions in excess of that critical speed, there was a certain region on each propeller blade which was incapable of contributing any more thrust, because the pressure over that region was zero. One could not get a negative absolute pressure, so that one would get a gradually increasing region on each blade which was incapable of giving any greater thrust as revolutions increased.

It had been shown by Admiral Taylor that for a certain type of propeller, driven at about 40 or 60 per cent. positive slip, face cavities were produced on the blades, and that, he had attributed to cascading over the blade face. If, however, the inflow velocity for that propeller were calculated, it would be found that the angle of incidence, instead of being positive, was actually negative over practically the whole of the blade, which accounted for the face cavities extending from the root right up to the blade tip. That explanation was much more simple than the cascading phenomenon. Face cavitation had been disposed of very largely by adopting wide blades, but we could not dispose of back cavitation, and all we could do was to try to keep it as low as possible. Finally, he suggested that a special cavitating tank might be included in the equipment at the National Physical Laboratory, in view of the importance of the cavitation problem and the possibility of solving it by direct propeller experiments.

Professor C. M. Carter asked whether the effect of appendages was included in the estimated E.H.P. given in the tables of propulsion data in fine weather, and what pitch the author had taken in his calculated values of thrust H.P. A ratio of effective to face pitch of about 1·02 was sufficient for designing a propeller when working on the naked E.H.P., but when one included the full E.H.P. with appendages, the figure was more of the order which Froude had given in his original 1908 paper.

Mr. M. P. Payne, discussing the measurement of S.H.P., asked whether or not the quiescent periods in the ship's motion, during which torsion meter readings were taken, tended to coincide with a condition of quiescence that might periodically occur in the state of the sea. If that were the case, there was some doubt as to whether or not a mean of such readings represented a true mean torque over the whole period. Probably a mean of such readings was the best that could be hoped for in any case, but it would add to one's confidence in the S.H.P. if the author would say that such periods of quiescence were consequent upon the relation of ship period and wave period rather than upon periodically occurring quiescence in the state of the sea. With regard to the author's table giving the steam trial results in fine weather for the Oropesa, he pointed out that the propeller was working practically at constant real slip, and therefore practically constant efficiency. It was disconcerting to find that the author's assessment of screw efficiency from trial results showed a constantly diminishing figure from 0·631 at 15 knots to 0·429 at 7·39 knots, and the discrepancy, he suggested, was accounted for partially by the adoption of a constant percentage loss of S.H.P. in transmission. The transmission losses in the bearings were considered, possibly, more nearly proportional to the revolutions than to the S.H.P., and if the 10 per cent. loss of power be assumed to apply at 15 knots, the percentage loss would be increased to nearly 35 per cent. of the S.H.P. at 7·39 knots, when the revolutions were approximately one-half, but when the S.H.P. had been reduced to roughly one-seventh that at the higher speed. A modification of the assessment of transmission loss on those lines would go a long way towards eliminating the anomaly with regard to propeller efficiency. That was important in establishing the substantial accuracy of the relative magnitudes of T.H.P. as calculated from revolutions at various speeds, upon which the estimate of wake, and its application to the rough weather results, depended.

Mr. H. J. R. Biles referred to his own observations as supporting Dr. Telfer's statement that one of the principal difficulties with torsion meters was to get the absolute zero fixed. Discussing a statement in the paper that in the case of the Oroya, for waves of only 4ft. high, with a wind of above 20 knots speed, the thrust required to propel the boat increased from 25 to 38 tons, or an increase of 52 per cent. over the thrust required in fine weather at that speed, he said that the dimensions and speed of the Oroya were intermediate between those of a 20-knot liner, 650ft. long, and a 400ft. cargo vessel of about 10 knots speed, which he had dealt with in his own paper on the effect of wind on power and speed, to be read later. He had found that, with a 20-knot wind, the percentage increase of resistance due to air resistance for the cargo vessel was 27·7, while for the liner the increase was 13·1. The margin between those figures and Mr. Kent's figure of 52 per cent. was very large, owing to the effect of waves. As to Mr. Kent's suggestion that that indicated the great importance of experiments in the tank to show what happened when a model was run in artificially produced waves, he said that it was known from model experiments that, in smooth water, the resistance of a 10-knot cargo vessel could be considerably reduced by carrying the longitudinal centre of buoyancy a great deal forward, but it was also known from experience that, if that were done to too great an extent, the performance of the ship fell off very badly in bad weather. The difficulty was to know where to stop in carrying the centre of buoyancy forward so that the performance in bad weather would be the best possible.

Mr. R. W. L. Gawn drew attention to the marked discrepancy between the screw efficiency figures deduced from the trial results and those given by Froude's curves, in the table giving propulsion data in fine weather for the Oroya, despite the fact that 10 per cent. of the S.H.P. had been assumed to be lost in transmission to the propellers. On previous occasions it had been suggested that this loss was probably 5 per cent., and if that figure were taken the discrepancy was still further increased. Probably a loss of as much as 5 per cent. from that cause would not readily be accepted by marine engineers, but it was most important to know the actual loss of power by friction in the shaft bearings, and he asked for Mr. Kent's opinion on that point. With regard to the author's calculation of the thrust H.P. of the propellers from Froude's data, he asked what was the excess of the analysis pitch over the face pitch. Froude's figure of 1·02 had been found by trial analysis to balance fairly reasonably the thrust H.P. calculated from propeller revolutions and ship speed with that deduced from the resistance of the hull without appendages. In order to balance the total hull resistance, inclusive of appendages, an analysis pitch factor of about 1·05 was found requisite on the average in warship speed trials. Further, if it were assumed —as was done in the paper—that 10 per cent. of the S.H.P. was lost in transmission, there would be little or no difference between the screw efficiency deduced from warship trial results and that obtained from Froude's curves, and, in fact, in many cases, the trial screw efficiencies would exceed those deduced from Froude's data. He asked what value Mr. Kent had used for the analysis pitch factor, and whether the E.H.P. figures in the table included an allowance for appendages.

Mr. Kent's explanation of the possible causes of a loss of efficiency of the propellers due to the interference of the flow past them by the run of the shaft webs was plausible. In the case of some high-speed cruisers and destroyers in the United States a similar explanation was deduced; the interference of the flow by the shaft brackets was considered to have been responsible for an appreciable loss of speed, the phenomenon being akin to cavitation. The large pitching amplitudes recorded in the voyages dealt with by Mr. Kent suggested the need for extending the scope of this research to include stress measurements. It appeared, as was frequently the case, that the pitching was more severe than the rolling. The rolling period at sea was very variable, especially in the case of the Oroya, in which ship the period fluctuated between nine and eighteen seconds, the natural period being sixteen seconds. It was clear that in these ships the waves influenced the rolling period greatly, and the statement that a ship at sea rolled broadly in her own period applied only when the waves were of very short period or near synchronism. Model experiments described by Mr. Payne three years ago had shown that, among uniform waves, the mean period of the ship followed that of the waves, and an explanation was suggested at that time. In some trials on a destroyer during the last two years it was found that the mean period of roll at sea in rough weather was approximately the same as that observed for the waves, and as a result it happened on many occasions that the actual period of roll was as low as six seconds, although the still water period was about nine seconds.

Mr. J. L. Kent did not reply to the discussion in detail at the meeting, but intimated that he would do so in a written communication. In reply to Dr. Telfer's point, he said he should think that every precaution was taken to see that the torsion meter zero was correct. He had not been able to take thrust readings, as suggested by Mr. Hamilton Gibson, on the Oropesa, but still hoped to be able to do so in rough weather. As to the analysis, 1·02 was the figure taken in the thrust ratios; the E.H.P.'s were naked E.H.P.'s. The actual efficiencies of the screws on the Oroya were low, and the owners were dissatisfied with the boat; she should attain a higher speed for the power expended.

The next paper to be taken was that on "Notes on the Effect of Wind on Power and Speed," by Mr. H. J. R. Biles. The paper is printed in full elsewhere in this issue.

Sir William Berry, who opened the discussion, said that Mr. Biles' demonstration of the possible adverse effect of the wind on measured mile results afforded a probable explanation of the cause of dissatisfaction with many trials results. In practice, too, a heavy seaway was usually associated with a high wind, and further prejudiced the results. Many inconsistencies in the performances of sister ships had been due to differences in weather conditions on the measured course. In the trials of a battleship—one of a series—which he had once attended there was a moderately fresh wind, force 4 to 5, say, a velocity of 18 miles per hour, and practically no sea. The results of the series indicated a loss of about a quarter of a knot at 18 knots, due to the weather conditions on this one trial. During the famous Greyhound trials in 1871 William Froude had obtained an approximate expression for the values of the air resistance by allowing the ship to drift before the wind. He had deduced that the air resistance was 330 lb. at 15 knots, corresponding to a pressure of 0·0037 lb. per square foot per knot, which was less than Mr. Biles' figure of 0·0043. It was probable that the latter figure was on the high side, because the experiments of Froude, Eiffel, Stanton, Dines, Beaufoy, and others in air and water suggested that the coefficient should be about 0·0038 for a plane surface square to the line of flow. In some of the speed trials conducted by the late Mr. R. E. Froude, where the data were accurately obtained and a pressure log was used to check the speed, so that the effect of wind was ascertained with reasonable accuracy on the individual runs, the opinion was formed that the air resistance deduced from the Greyhound trials was, if anything, on the high side. Another interesting result had been given in a recent account of the maiden voyage of the Hapag liner Hamburg across the Atlantic, in which it was reported that with a head wind of gale force—velocity 39 to 46 miles per hour—and no appreciable seaway, the measured thrust was about 10 per cent. greater than the fine weather value. The speed on that occasion was about 16 knots, and the relative wind velocity about 50 knots. Mr. Biles' table dealing with air resistance in the case of the 20-knot liner gave higher figures than that. Finally, Sir William said it should be borne in mind that the model, when tried in the tank, was usually complete as regarded hull up to the weather deck, and E.H.P., therefore, included the air resistance of that part of the model, but did not include any superstructure, bridges, funnels, &c., which greatly added to the total resistance.

Mr. G. S. Baker expressed agreement with Mr. Biles, and said that the results of experiments on air resistance of models in the wind channel supported the formula given in the paper.

Mr. J. Reid referred to his own experiments, which, though similar to those of Mr. Biles, were conducted in order to find out what caused the disturbance of the delivery of the air to the fans in high-speed vessels. A great deal of the loss found in the trials of a high-speed vessel, facing a heavy wind, might be related to the fact that the currents of air passing over the ship missed the ventilators, and that the fans had to struggle to get their supply, but he had never seen any statement that that cause of loss of power and speed had been studied in connection with the question of air around a ship. Though he had little doubt that Mr. Biles had arrived at a very fair estimate of the resistance due to air striking a vessel, say, from the bow, so far as trial trip conditions were concerned, it was necessary to relate trial trip data to sea-going conditions, and he was satisfied that if

one tried to use Mr. Biles' formula on an Atlantic liner, it would be found that he had underestimated the air resistance. That was due to the fact that, when a large vessel was travelling at 20 knots or over, it was carrying around with it a tremendous body of air. The air was passing round the ship and forming eddies and swirls at distances from the ship which very few people had any conception of. Altogether, there was a tremendous wind resistance at high speeds, and the combined or relative speed of an Atlantic liner might easily go up to over 100 knots. In a reference to the fashion for funnels—which might be influenced by the fact that to the prospective passenger the presence of funnels suggested power and speed—he said that those funnels had to be paid for, and in the case of a large funnel, such as was used on an Atlantic liner, it would be found that every ventilator within 50ft. or 60ft. behind it was completely upset as regarded delivery.

Mr. Hugh Biles, in his reply, derived comfort from the differences of opinion which had been expressed by the speakers in the discussion as to the correctness of his estimate. It had been suggested by Mr. Reid that he had underestimated the resistance; Sir William Berry had mentioned the sea-going results obtained from a German liner, from which it was deduced that there was an increase of thrust of only 10 per cent. on a relative speed of 50 knots, which would show that the resistance given in the paper was over-estimated; and Mr. Baker had thought that the values given in the paper were about correct. Altogether, it would seem, therefore, that his values were not far off the mark, but he agreed that results from several types of vessel were needed in order to corroborate those values. The discussion demonstrated the necessity for experiments in the wind channel at the tank, in order to see exactly what sort of coefficients would be obtained in the formula for calculating air resistance.

Inasmuch as the Duke of Northumberland was to be unable to attend the final session in the afternoon, Mr. Francis Henderson took an opportunity at the end of the morning session to express thanks to him for the dignified and impartial manner in which he had presided over the meeting, and said how helpful was the President's intelligent appreciation of the great importance of the very technical subjects discussed.

The vote of thanks was carried with acclamation.

The President, in a brief response, expressed his gratitude for the support extended to him, and the pleasure it had given him to preside at this, his sixth, Spring Meeting of the Institution. The standard of excellence of the papers and discussions had been maintained, and the increasing interest which was being taken in the proceedings of the Institution was demonstrated by the increasing attendance.

In the afternoon session, at which Sir John Biles presided, the following papers were read and were discussed together:—"Ship Resistance Similarity," by Dr. E. V. Telfer, and "Ship Wave Resistance," by Mr. W. C. S. Wigley, of which the following are abstracts:—

SHIP RESISTANCE SIMILARITY.

The resistance similarity of geometrically similar ship forms is governed simultaneously by the Froude and Reynolds laws. The simultaneous application of these laws being physically impossible, ship model technique has developed along lines which accept the Froude law, owing to its practical simplicity as the primary, and respect its fundamental requirements, in spite of the fact that in the majority of cases the quantity of resistance governed by this law is less than that governed by the Reynolds law. This latter law is studied only in so far as it enables its empirical lessons to be more accurately applied as corrections to the Froude law.

Starting, however, from a consideration of the inter-relation of the specific total resistances of a family of geometrically similar models, it is evident that each model over its speed range covers not only a range of Froude speed-ratio, but also a range of Reynolds speed product. It follows therefore that interpolation of the data can at once be effected either in the form of resistance contours of constant speed product to a base of speed ratio or contours of constant speed ratio to a base of speed product. By this interpolation we therefore virtually secure the simultaneous application of the Froude and Reynolds laws.

A consideration of this interpolation reveals the various fundamental aspects of its structure, it being principally shown that the resistance contours above mentioned must, in either presentation, be mutually parallel. To develop this interpolation to be of practical assistance in model technique, it is therefore first shown that the correct function of speed product to use must be of the form $f\left(\frac{\nu}{V.L}\right)$, thus showing that extrapolation does not involve an infinitely large viscous parameter, but one which for the largest conceivable ship approaches zero. Next, the form of this parameter, which makes the speed-ratio contours straight lines, is demonstrated, first by reference to Stanton and Pannell's work on the flow of water through pipes, and subsequently by tests on geometrically similar ship models. This condition of linear parallelism is shown to be of the greatest value in using the whole of the data to secure the most probable extrapolation to the ship, and numerical examples of the ship resistance thus obtained are given, showing incidentally, in the cases examined, their close agreement over the practical range of speed ratio, with the values found by the classical or Froude method.

The mechanism of the classical method is then discussed in the light of the general method and its limitations pointed out. The alternative use of temperature change instead of model size to apply the general method is next examined, and an example given showing the possibility of securing valid extrapolation to the ship by this means alone.

For the correct application of the methods of this paper, the family of models tested must, however, be run under conditions which secure complete turbulence of the tank water. The distorting influence of laminar flow is discussed in this connection, examples are given showing its importance, and the means adopted to secure its elimination are discussed.

Finally, various minor aspects of comparative ship resistance which appear to be of interest in the light of the methods of the paper are reviewed. Principally in this connection, it is pointed out that whilst with the classical method the order of superiority revealed in testing two models of equal length and wetted surface is immediately presumed as holding good for the ship, this assumption not only has no counterpart in the more general method, but is probably invalid when comparing two forms which are likely to differ materially in the composition of their total resistance.

SHIP WAVE RESISTANCE.

This paper forms the second part of that which was presented by the author at the 1926 spring meetings of the Institution, entitled, "Ship Wave Resistance: A Comparison of Mathematical Theory with Experimental Results." It continues the discussion of the wave resistance of two further ship forms which can be defined by mathematical theory, which is deduced from model experiments by the use of Froude's skin friction data, and that which is calculated from mathematical theory. The two new forms tested were derived from a successful model used in the previous test, and are made to the same lines but with reduced beams of $\frac{1}{4}$ and $\frac{3}{4}$ of that of the parent model. The experiments are described in the paper and both calculated and experimental curves are given and compared. The paper is supplementary to that of the previous year, and the author expresses the hope that it may be of some use in bridging the too wide gap at present existing between the mathematical theory of ship wave resistance and the results of actual experience.

Mr. H. G. Williams, who referred to Dr. Telfer's paper as one which might possibly be reckoned as epoch-making, said that its most important and interesting features were, first of all, the suggestion of a new method of deriving the resistance of a ship from model experiments, and, secondly, the suggestion of an expression for frictional resistance in accordance with dimensional requirements. The practical value of the first suggestion was to some extent dependent on the second. The author's method of deriving ship resistance from model experiments was, in its most general form, a method of graphical extrapolation, and did not depend on any law of viscous resistance, except the law that such resistance was some function of the dynamical viscosity divided by the product of the speed and length of the ship or model. Its recognition of that law made it theoretically superior to the Froude empirical law of frictional resistance. It did depend, however, just as did Froude's method, on the assumption that total resistance was the sum of viscous and inertia resistances. In effect, that implied the assumption that the equation—

$$\frac{R}{\rho . A . V^2} = f\left(\frac{V}{\sqrt{g . L}}, \frac{\nu}{V . L}\right)$$

could be written—

$$\frac{R}{\rho . A . V^2} = f_1\left(\frac{V}{\sqrt{g . L}}\right) + f_2\left(\frac{\nu}{V.L}\right)$$

On the face of it, it did not appear probable that that assumption was strictly correct, but it was always made, and must be accurate enough for practical purposes, and, moreover, it seemed to be absolutely indispensable to enable ship resistance to be dealt with at all.

After some detailed criticism of the paper, Mr. Williams suggested that the running of a whole family of models, in order to get the resistance of one ship form, would be very expensive, and that the expense would put the author's extrapolation method out of court for practical purposes as a rival of the existing practice. The practicability of the method, however, would be materially improved if the author's expression for viscous resistance—

$$\frac{R}{\rho . A . V^2} = a + b\sqrt[3]{\frac{\nu}{V . L}}$$

were established, since the constant speed ratio lines then became straight lines. If that equation were correct, assuming that a and b were positive constants, it would mean that the specific viscous resistance of any body to which the equation applied would necessarily increase with the speed. If b were a negative constant, it would mean that the specific resistance decreased as the speed increased. Neither of those propositions was borne out by results he had seen of experiments with model submarines submerged in water or model airships in wind channels; but, of course, it was quite possible that wave-making in the one case, and non-turbulent flow in the other, might have entered into the results. Generally, the author had made out a good case for the extended trial of his proposed viscous resistance equation in the analysis of model experiments. If it were so used, it would, for some time to come as far as he could see, be necessary to run two similar but different-sized models to get the resistance curve of each full-sized ship, in order to give the slope of the constant speed ratio lines. If the models were then run at very low speeds, it would be possible—with perhaps the help of a wire fitting to produce turbulent flow—to obtain the $V/\sqrt{L} = 0$ curve, and thus the complete curve of viscous resistance for the form. In that way the values of the constants a and b in the formula would, in time, be correlated with geometrical parameters defining the form of the model, and thereafter it would be necessary to run only one model in order to obtain the resistance curve of any ship form in all its possible sizes.

The practical importance of the paper depended entirely on the final conclusion arrived at, as to the correctness in form for ship-shaped bodies in the formula for viscous resistance which the author had put forward. That point could be decided only after analysis of all cases in which two or more geometrically similar models had been under experiment, and probably only after additional experiments had been made expressly to test the formula.

Professor T. B. Abell expressed the view that Dr. Telfer's method of plotting to the parameter of $\nu/V\,L$ promised to give some very useful data in the future. In Fig. 1 of the paper Dr. Telfer had plotted Stanton and Pannell's results to the new parameter $(\nu/V\,L)^{\frac{1}{3}}$. It had a constant ordinate at the zero value of about 0·0008, and the extrapolation was a very short one. The Lecturer in Hydraulics at the University of Liverpool—Dr. H. Mawson—had been carrying out experiments on viscous flow in centrifugal pumps, and had been studying the question closely, and after seeing Dr. Lees' formula, which contained the inverse of Dr. Telfer's parameter, he had suggested that the constant in the final expression for the specific resistance had a definite physical meaning. Dr. Telfer had referred to the same point when he had said that the index $\frac{1}{3}$ followed direct from the dimensional reasoning based upon the inclusion of the speed-length product of turbulence, and the constant a from the fact that ultimately the change in velocity distribution brought about by viscous action approached a constant value. Dr. Mawson had suggested that when ν equalled 0 that ordinate must represent the resistance equivalent of the eddies which viscosity had originally set up. If that were so, one might get some very useful data by carrying out experiments on submerged forms, when surface disturbance was eliminated, and plotting the results from those submerged forms on the same parameter. Then that ordinate would represent accurately the turbulence or the energy in the eddies of the models. Taking the case in which $V\,L$ was infinite, one practically eliminated the effect of viscosity, and that had been observed in aeronautical experiments, *i.e.*, that the higher the speed the more nearly was specific resistance a constant.

Mr. M. P. Payne, discussing Dr. Telfer's paper, said that the foundation of the author's work rested on the adoption of a particular form of function to specify "specific viscosity resistance," and thereby extrapolate to ship speeds and lengths to obtain the ship resistance. In the synopsis of his paper Dr. Telfer had said that it was shown that the correct function of speed product to use must be of the form of $\nu/V\,L$. The only reference to that point that he (Mr. Payne) had been able to find in the body of the paper, however, was the assertion that the speed-product was physically required to be of the form $\nu/V\,L$ and not $V\,L/\nu$. If the correct form of the function were known it was a matter of indifference which of those variables was used—except for practical convenience. If, however, the function were known only over a limited range, then any extrapolation was largely a matter of taste, guided by physical considerations, and no greater accuracy was to be expected in extending $\nu/V\,L$ down to zero than in extending $V\,L/\nu$ to infinity, since the change in the physical conditions was infinite in either case. With regard to the demonstration in the appendix, which attempted to prove that $(\nu/V\,L)^{\frac{1}{3}}$ was a more basic variable than $\nu/V\,L$, Mr. Payne confessed that it was rather unconvincing to him. If any resistance, which was governed by turbulence, could be expressed by the formula proposed by the author, one would expect it to apply to the resistance of circular cylinders in which the vortices produced accounted almost entirely for the resistance, but it did not appear well adapted to fit the experiment data in this instance. Again, it had been shown by Dr. Stanton that, in what had been accepted as turbulent flow, there was always a thin layer of fluid adjacent to the solid boundary in which the flow was laminar, and that the shear stress in that layer was equal to the specific resistance.

It appeared, therefore, that no sharp differentiation between laminar flow and turbulent was possible, and a formula which purported to be based on considerations of turbulence and ignored laminar motion could not be valid. The correct calculation of the temperature effect on skin friction and the analysis of the model run at different temperatures did not really confirm the plausibility of Dr. Telfer's basic formula, as he had asserted, except over the model range. The same temperature correction had been deduced at Haslar from the Froude formula for skin friction. So far as the practical application of the basic formula was concerned, Dr. Telfer had taken the expression $b\,(\nu/V\,L)^{\frac{1}{3}}$ as the formula for "skin friction correction" in passing from model to ship, and would determine the value of the coefficient b by running two or more models of different scale, rather than assess it from extrapolated plank data. It was doubtful if that was a more accurate procedure, unless it could be proved definitely that the expression proposed was theoretically correct.

The separation of the total resistance into "specific viscosity resistance" and "specific inertia resistance" was quite artificial, although, of course, of great practical importance. Actually, the viscosity of water must affect the flow and wave pattern compared with that for a perfect fluid, and the resistance of a ship in a perfect fluid appeared to be the only rigid definition of wave-making resistance. With Dr. Telfer's proposed extrapolation for "specific viscosity resistance," however, at infinite speed-product, which corresponded to zero kinematic viscosity as for a perfect fluid, the total specific resistance would still consist largely of specific viscosity resistance. Finally, Mr. Payne said that although he believed there were

many who would be unable to agree with the basis of the method of analysis which Dr. Telfer had proposed, he was to be congratulated for the stimulating and interesting paper which he had presented.

Mr. W. C. S. Wigley said that any increase of accuracy in the estimation of skin-friction resistance would be of particular value to him as affording a better opportunity of checking his own work on wave resistance. He had made a few calculations for the forms for which he had calculated the wave resistance and had found that the curve of the type

$$\frac{R}{\rho.A.V^2} = \left[a + b\left(\frac{\nu}{V.L}\right)^{\frac{1}{4}}\right]$$

differed less than 1 per cent. anywhere in the range of his experiments from the Froude curve of friction resistance if the constants were chosen to make the curves agree at the ends, *i.e.*, if the constants were so chosen as to fit Froude's and other experimental results on planks. With regard to Dr. Telfer's statement that the relation

$$\frac{R}{\rho A.V.^2} = f\left(\frac{V.L}{\nu}\right)$$

did not account for any possible difference between turbulent and laminar flow, he said that surely that difference would appear in the form of the function f if it could be accurately calculated. The present empirical formulæ, such as those given in the paper, could only apply strictly to the range of Reynold's number covered by the experiments on which they were based, but if the form of the function f could be mathematically calculated from the known differential equation of the motion, that relation would take account of all the phenomena of the motion except so far as surface effects were concerned. He could hardly agree with Dr. Telfer that greater accuracy in extrapolation was obtained by plotting on a base of the reciprocal of the Reynold's number. The base was contracted at the high-speed end by so doing, but any curvature in the graph was also automatically exaggerated, so that there was no net gain. The criterion for selection of a base on which to extrapolate was surely that the graph, through the experimental spots, should be as nearly a straight line as possible. In the paper no effort had been made to select the best base on those grounds, but straight lines on the base selected to fit the theory had been forced through the experimental spots as nearly as possible. With reference to the appendix giving Herr Kozeny's explanation of how a physical explanation might be given for the peculiar index of $\frac{1}{4}$ occurring in Dr. Lee's formula, Mr. Wigley suggested that it should be made clear, as it was by Herr Kozeny in his original paper that that was only a a rough analogy, and in no sense a mathematical proof of the formula.

Mr. J. Tutin objected to Dr. Telfer's theoretical derivation of his method of tracing the results. First of all, he had assumed complete turbulence, but he was not justified in that. Secondly, he had assumed that the turbulence in the fluid was a pulsation and that it had a period. Thirdly, he had assumed that this periodical pulsation was a simple harmonic motion. That assumption should be supported either by further mathematical research or by direct experimental observation of the pulsation; as far as he knew that had not been done in this country.

Both authors indicated that they would reply fully in writing to the points raised.

The meeting was concluded with expressions of congratulation by Sir John Biles upon the success of the meeting and the papers and discussions, and upon the fact that the younger men in the profession were so active. It was pleasing to see, he said, that the science of naval architecture was growing, and that the Institution was developing, both in membership and in utility.

The Electrical Industry.

THE April issue of the quarterly publication "Trade Survey," published by the British Electrical and Allied Manufacturers' Association, has just come to hand. The economic situation in Great Britain and the main industrial countries is surveyed, principally with a view to determining the competitive position and to forecasting the trend of business activity generally. Although the electrical industry is not singled out for special treatment, it is reviewed in a prospective which includes other industries of furldamental importance. A comparison of the output of electricity in Great Britain, the United States, Germany and Canada, over the three years 1924–1926, illustrates the real loss in production caused by the coal stoppage in Britain in 1926. Both in 1924 and 1925 production in all four countries moved upwards in almost exactly the same ratio, but trade depression in Germany, which reached its lowest point in June, and the disturbances in Britain, brought all four curves out of phase in 1926, the United States leading easily, with Canada a close second. Germany recovered in September and reacted to the demand for fuel and metallurgical products, consequent on the lack of supplies in Britain, rising to the American level at the end of the year. From December, 1926, onwards, the upward movement in Britain and Germany was resumed in close harmony, while a decline took place in the United States. Expansion is greatest now in Britain—a satisfactory indication of improving conditions in trade generally, and a sign of increasing orders for electrical plant and apparatus.

The total capacity of all plant installed in Germany in 1925 was 19,308,512 horse-power, of which 12,892,718 represented the capacity of electric motors. In addition, transport and road vehicles of all kinds, including railway locomotives and ships, totalled 36,956,972 horse-power, the German State Railways accounting for 27,300,000 horse-power, including electric locomotives, and shipping for 2,100,000 horse-power. German industry is even more highly electrified than American industry, and this achievement has been the work of thirteen years, 1907–1914, 1919–1925, almost exclusively. In 1907 the total capacity of power in all industries was 7,746,076 horse-power, and between that date and 1925 9,900,000 horse-power were added, whilst in the same period electric motors increased by some 10,000,000 horse-power, so that electrification dominated expansion of manufacturing equipment during the time when German industry was moving towards its greatest standards of production and competitive efficiency. The increase in the electric motors installed in the mining industry from 1907 to 1925 was 737 per cent.; in iron and steel and metal industries, 958 per cent.; in engineering, 634 per cent.; in textiles, 633 per cent.; in paper, 410 per cent.; in chemicals, 843 per cent.; in electrical manufacture, 770 per cent.; and in all industries, 663 per cent. Comparison with British industries in the same category shows how great is the deficiency to be made good in Britain. To reach the same degree of electrification as that obtaining in Germany and to employ a similar machinery power per unit of output, seven industries require additional electric motors aggregating over 2,000,000 horse-power. Only railway carriage and wagon building, grain milling and rubber manufacture can bear comparison with similar German industries. The ten industries noted cover about 50 per cent. of the plant installed in British industry, so that a fair estimate of the national deficiency would lie between 3,800,000 horse-power and 4,000,000 horse-power, a total of not far short of 70 per cent. of all the electric motors now operating.

These statistics illustrate the immensity of the field waiting to be cultivated by the electrical manufacturer, and at the same time the very serious handicap under which he labours in his struggle against German and American competitors. The American manufacturer with American industry employing 24,000,000 horse-power of electric motors, has four times the market, and the German manufacturer more than twice the market open to the British manufacturer who must suffer, in addition, from the effects of unrestricted competition at home. The demand for industrial motors alone may reach an annual value in the United States of over £10,000,000, in Germany over £5,000,000, while in Britain it may be only £1,600,000. The possibilities of large-scale production in the United States and Germany, with a resultant decrease in overhead costs per unit of output, are evident from these statistics. The British manufacturer, forced to discover 30 per cent. of his market overseas, can neither standardise his types of motor, nor embark on standardisation to any great extent, with the result that mass production methods cannot be widely adopted.

The position in British industry itself, through its inability to adopt electrical machinery and modernise equipment, threatens a crisis in production which can only be avoided through a policy of renewals and replacements and extensions of manufacturing plant of the most far-sighted and thorough nature. To encourage it to do so, the price of electricity should be such as to justify, on economic grounds, conversion to the electric drive, and it is at this point that the work of the Central Electricity Board, so tentatively and carefully begun, should have most value. It is clear, however, that speed in development is essential, both on the industrial and electricity supply sides, and while there are indications of activity on the part of the Central Electricity Board, trade depression, as well as financial stringency, retard enterprise in industry.

Although the total turnover of the electrical industry was slightly less in 1926 than in 1924, owing to the interruption in the normal state of trade caused by the return to the gold standard in 1925, and the subsequent depression in the home market during that year, it could report in 1926 a record flow of orders. There are indications that a similar result will accrue in 1927, provided that progress is begun on the national power scheme. In the small industrial motor section, however, conditions were unsatisfactory, through the inability of industry and transport to earn sufficient profits to justify installation of electrical plant in manufacturing processes. Through comparison between similar industries in Germany and Britain, it was found that, to reach the same standard of electrical development as that obtaining in Germany, the coal industry required 800,000 horse-power of electric motors, the iron and steel industry 700,000 horse-power, the cotton industry 500,000 horse-power, while, for all industries, the deficiency could be estimated at 4,000,000 horse-power.

In exports, the British electrical industry maintained the position of principal supplier to the world's markets—even throughout the disturbance in supplies of raw materials and shipments caused by the coal stoppage—and for the first two months of 1927 it more than held its ground. The position in exports is satisfactory, as a result of important orders placed within the last six months by Australia, New Zealand, South Africa, India, Japan and Russia, while a revival of demand for machinery is reported in Europe. The British competitive situation is sound, even at the present level of prices, since quality and efficiency of operation have decided the issues in almost every important contract.

The survey concludes with a note of restrained optimism regarding trade prospects generally:—"The threat of depression in trade, accompanied by under-consumption, can be traced in turn partly to excessive production, and partly to credit difficulties. The position has not yet been evened out, and until this occurs trade revival cannot be expected. Toward the end of this year, improvement of a lasting nature may, however, be expected."

ACCORDING to an address given by Mr. W. G. Pape to the Railway Students' Association, the London termini of the Southern Railway receive each morning between 7 and 10 o'clock no fewer than 456 trains, from which, on an average, 1000 passengers per minute detrain.

Books of Reference.

"THE Colliery Year Book and Coal Trades Directory, 1927," published by the Louis Cassier Company, Ltd., 22, Henrietta-street, Covent Garden, London, W.C. 2, price £1 1s.—This book of reference, which now appears in its fifth year of issue, has rapidly made an established position for itself. It contains first of all an official section, which embodies information concerning the Mines Department, the Mines Inspection Division, the Mining Association of Great Britain, the Coal Owners' Association, the Miners' Federation, Trades Unions of the Coal Industry, Mining, Scientific and Technical Institutions, &c. Then there is a colliery section, which gives an alphabetical list of colliery owners, with their mines, names of directors, officials, &c.; a mines index; mines regulations, and particulars concerning blasting in collieries. Then follows a series of special articles, including:—"Some Notes on Machine Mining," "The Dispute in the Coal Industry in 1926"; "New Wages Agreement"; "The Future of the Coal Mining Industry," by Mr. Austin Hopkinson; "Co-operative Selling in the Coal Mining Industry"; "The Rhenish Westphalian Coal Syndicate"; "Review of the Coal Mining Industry in 1926"; and "Review of the Coal Trade in 1926." Then there are some most instructive statistical tables and other information concerning coals, blast-furnaces, coke makers, gasworks, and electricity undertakings, and finally there are a coal trades directory, a personal index and a directory of manufacturers of colliery plant, machinery and stores. Altogether it is a most useful book.

"DIRECTORY of Paper Makers of Great Britain and Ireland," published by Marchant, Singer and Co., 47, St. Mary Axe, London, E.C. 3, price 5s. net.—With this year's issue, this useful book of reference enters upon its second half century of publication. It is so well known, therefore, that it needs no introduction from us. It contains, as in past issues, alphabetical lists of paper makers in England and Wales, Scotland and Ireland; a list of paper enamellers, surfacers, gummers, &c.; lists of paper makers' representatives and paper agents in London and the provinces and of London wholesale stationers; lists of mills; a classification of makers with makers' names; trade designations used by paper makers, wholesale stationers, &c.:—(1) Actual water marks; and (2) trade names, not being actual water marks; addresses of firms referred to under trade designations; paper trade customs; standard names and sizes of papers and boards; sizes of papers; paper trade publications, &c.

"THE S.A. Mining and Engineering Journal Year Book." Apart from that section of the South African Year Book which is of a purely directoral nature, and which is well organised for easy reference, both as regards names, trades, and occupations, there is in its 450 odd pages a fund of information which might be analysed in many directions. There is, for instance, a list of all the electricity undertakings in South Africa, from which it may be discovered which is the most popular method of generating and distributing electricity. In this connection it is noteworthy that the Year Book shows that there is a tendency for the smaller stations to scrap internal combustion engines and to revert to steam plant. The scope of the Year Book ranges geographically from the Cape right up to the Congo, and industrially throughout all the various trades carried on within the Union. It is obtainable in England at 72, Fleet-street, E.C. 4, at the price of 12s. 6d. post free.

THE CERAMIC SOCIETY.

THE Ceramic Society has arranged to hold its Spring Meeting this year in Czechoslovakia during the period April 30th to May 16th, and has prepared the following provisional programme:—

The party will leave London on Saturday, April 30th, at 10 a.m., and will arrive at Karlovy Vary (Karlsbad), 4 p.m. on Sunday, May 1st. The Monday and Tuesday will be spent in Karlsbad, and the following will be visited:—The Pirkenhammer Porcelain Works; Karl Knoll, Fischern; Chodau–Electro-osmose purification of clays; and the Zettlitz Kaolin Works.

On the Wednesday the party will leave for Praza (Prague), and be welcomed at the railway station there by representatives of the Czechoslovak Ceramic Society, the evening being spent at the National Theatre. On the Thursday there will be sightseeing in Prague in the morning and a reception by the Mayor of Prague, Dr. Baxa, in the Town Hall of the City. In the afternoon a visit will be paid to the Castle of Hradcany and the Cathedral of St. Vitus. In the evening a dinner will be given by the Czechoslovak Ceramic Society.

On the Friday morning there is to be a joint meeting of the Czechoslovak Ceramic Society and the British Society, when papers will be read by Dr.-Ing. R. Barta and Professor Dr.-Ing. O. Kallauner and by members of the British Society. The Honorary Diploma of the Czechoslovak Ceramic Society will also be presented to the British Society. In the afternoon there will be a motor excursion to Karluv Tyn (Karlstein) and a visit to the Castle, while in the evening the Czechoslovak Ceramic Society will be entertained to dinner by the visitors.

On the Saturday there will be an excursion in the morning to the Rakovnik (Rakonitz) Works, near Prague, and in the afternoon a visit to Horni Briza and the West Bohemian Kaolin and Chamotte Works. The party will leave Prague for Brno (Brünn) on Sunday, May 8th, breaking the journey at Blansko to make a motor excursion to the Cavern of Macocha and the Masaryk and Sloup Grottoes, and on the Monday a visit will be paid to the Silicate Institute of the Czecho-Polytechnical School, &c., in Brno in the morning; and the afternoon a departure will be made for Vienna.

Alternative arrangements have been made for the time spent in Vienna and its neighbourhood, of which, as well as of the rest of the trip, further particulars can be obtained on application to the general hon. secretary of the Society, Dr. J. W. Mellor, North Staffordshire Technical College, Stoke-on-Trent.

Paint-making Machinery.

No. III.*

As we have already described the general characteristics of the triple-roller paint mill, it will be unnecessary to go over them again in the following notes on some alternative designs, and we will confine ourselves to the distinctive features of one or two other makes.

The mill—shown in Fig. 11—is by Brinjes and Goodwin, Ltd., of Cold Harbour, Poplar, London, E. 14, and is chiefly noteworthy on account of the method adopted for driving the rolls. The gear, as will be seen from Fig. 10, is entirely of the helical type, and the makers claim that the smoothness of running thus obtained enables the mill to grind a larger amount of paint than is possible with straight toothed gearing. The machine certainly does run exceptionally quietly and without any appreciable vibration. The gears are all mounted in a box cast in one with the side frames, and revolve in an oil bath.

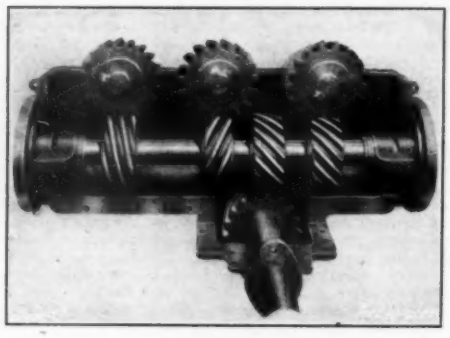


FIG. 10—HELICAL DRIVING GEAR

The main driving shaft, from the belt pulley or motor, is carried across the machine and enters the gear-box through a stuffing-box. It drives a short lay-shaft, through helical gears, which runs in ring-oiled bearings, and has ball thrust washers at either end. On this lay-shaft there are mounted the three gear wheels which mesh with those of the three mill rolls. It will be noticed, on reference to Fig. 10, that the pitch of the several gears is so devised as to give the differential action between the adjacent pairs of rolls, to which we have already alluded. Incidentally, as will be noticed, the outside wheels on the lay-shaft are somewhat wider than is necessary for ordinary meshing, so that they may continue to operate as the rolls are brought together to take up wear. The extent to which this adjustment may be carried, without impairing the proper running of the gear amounts, we understand, to the rolls wearing away by the half of an inch.

It is noteworthy that while the makers supply rolls of granite, porphyry, and chilled cast iron, they seem, to us, to have a predilection for porphyry for fine work; but in either case the rolls are trued up with great exactitude. In the case of iron rolls for ordinary work, for instance, the feed and middle rolls are ground as nearly parallel as is possible, but the third roll is given a faint camber. This camber amounts to a matter of only a thousandth of an inch or so across the width of a 36in. roll, and is slightly accentuated at the extreme ends. The result is that any hard pieces of pigment or foreign matter which will not pass between the rolls, gradually work their way to the outside ends of the rolls, where there is sufficient clearance for them to pass, and accumulate in a convenient position to be scraped off, as occasion may demand, by a pallet knife. It is also noteworthy that Messrs. Brinjes and Goodwin advocate the employment of rolls which do not pair in diameter. Thus the first and second rolls are of approximately the same size, but the delivery roll is appreciably larger. The reason given for this arrangement is that, by grinding the material through "two different angles," much more fine grinding is secured than is possible when the angles of contact—or, should we say, approach—are the same between the two pairs of rolls. The differential action in the matter of peripheral speed of the several rolls is, of course, maintained, and the different diameters insure that with each revolution the rolls make contact at a different point round the circumference. In the case of stone rolls, the stones are keyed and cemented to their shafts with a special cement, which has the property of expanding as it cools, and consequently makes a very secure joint.

The lateral movement of the centre roll, to minimise grooving or local wear, is in the Brinjes mill effected by a pair of simple cam plates, one on either end of the roll, in conjunction with presser pads fixed to the main frames—as shown in Fig. 14. The pads have spherical seatings, so that they can follow the varying contour of the cams, and are mounted on adjustable stems to minimise any backlash at the end of each stroke of the roll.

The grinding pressure between the rolls is supplied by the compression of springs, which are so enclosed in the housings—see Fig. 13—that they cannot become clogged up with falling scraps of paint, and the hand wheels for adjusting these springs are plainly shown in Fig. 11. The adjustment for the back roll is, it will be seen, effected by levers and long spindles for the convenience of the operator at the front of the machine.

The scraper, or doctor, and the delivery apron of these mills are specially devised for convenience in cleaning up the machine after a run, and can be lifted off bodily without disturbing any of the adjustments. The apron is of cast iron, and the doctor of hard steel, and the latter is recessed into the casting in such a manner that the face over which the paint is delivered is really flush, and there is no liability for any accumulation to pile up. The supports for the whole assembly hinge round the bearings of the front roll, so that adjustments of the roll do not affect the angular position of the doctor knife, and its pressure against the roll is determined by pendant weights.

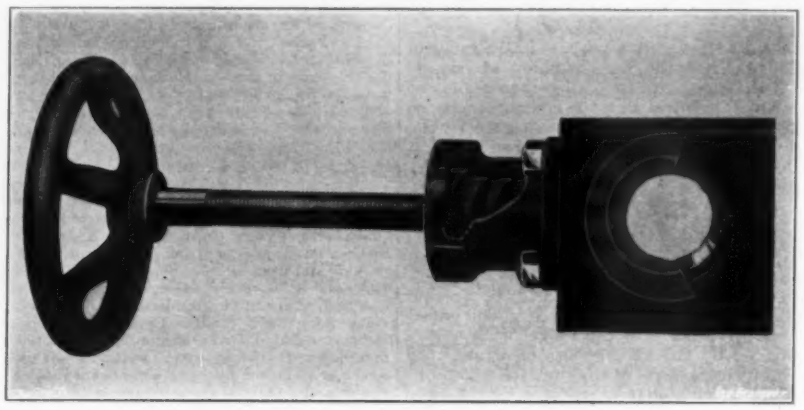


FIG. 13—SPRING ADJUSTING GEAR—BRINJES AND GOODWIN

An alternative arrangement of adjustment for the doctor knife is by means of a hand wheel and spring—as shown in Fig. 11. With this arrangement the pressure of the knife on the roll is equalised throughout its length, by means of a system of levers; but the pressure on either end can, if it is required on account of exceptional circumstances, be adjusted independently of the pressure on the other end.

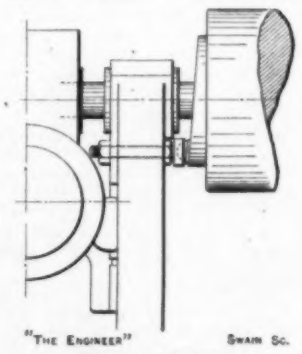


FIG. 14—CAM GEAR

Another system of driving triple roller mills is that adopted by Marchant Brothers, Ltd., of Verney-road, London, S.E. 16. In it, chains are used to drive the outside rolls, as shown in the drawing—Fig. 15—while Fig. 12 represents a mill of this type with a twin roller mill superimposed.

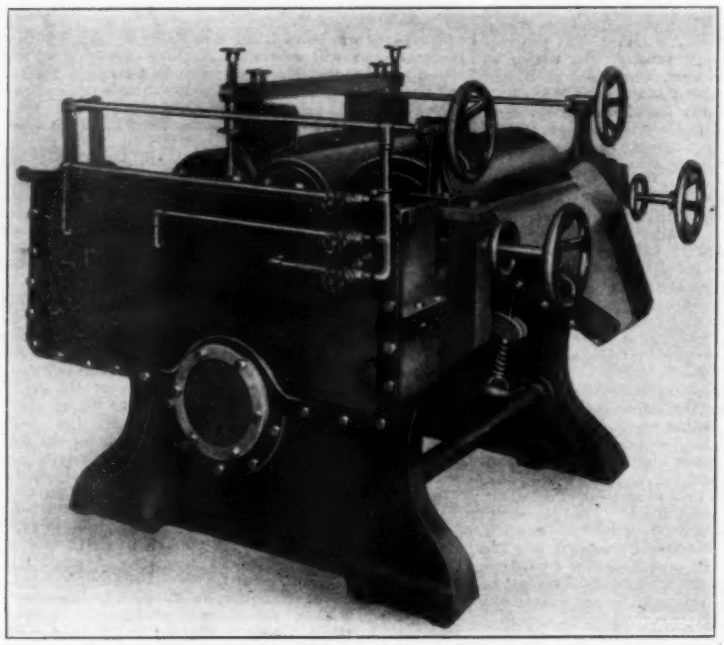


FIG. 11—THREE-ROLLER MILL—BRINJES AND GOODWIN

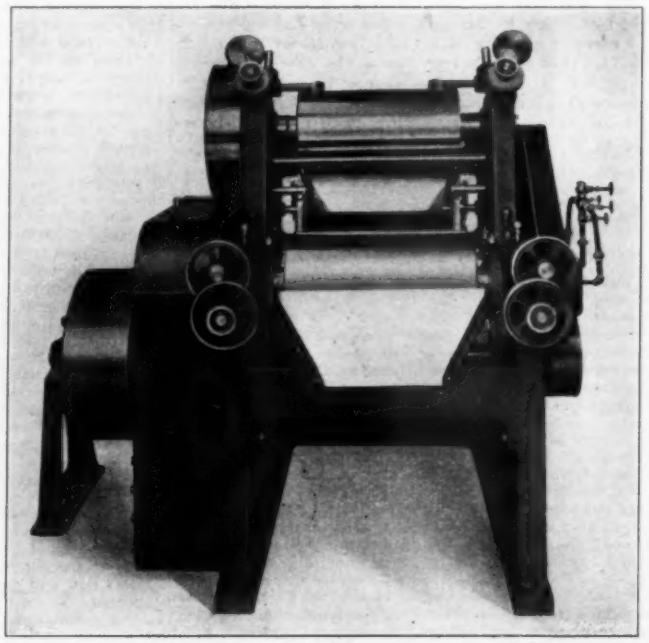


FIG. 12—FIVE-ROLLER MILL—MARCHANT

* No. II. appeared April 15th.

On reference to Fig. 15, it will be seen that the main driving shaft is geared directly with the centre roll and also with two short shafts in the bottom of the gear-box. The box, by the way, is of cast iron and totally enclosed, so that it acts as an oil bath. The two lower shafts are connected with the outside rolls by means of sprockets and roller chains, which rise vertically in the mean position of adjustment of the rolls. The result is that the driving force is applied to the rolls truly tangentially, thus minimising the gear influence on the rolls so that there is no tendency for it to interfere with their horizontal adjustment. There is a jockey pulley on each of the chains for taking up any slack caused by wear or the movement of the rolls.

The adjustment of the rolls is effected, in these machines, quite positively in the following manner. Inside the outer bearings, and between them and the housing of the centre roll, there are adjustable stops. These stops are formed as two pieces screwing one into the other, with a fine thread. On the outer part there is cut a worm wheel, which gears with a worm arranged vertically on the side of the main frame. The top end of the worm spindle is cut to accommodate a key, which is retained by the foreman of the grinding shop, and is provided with a pointer working over a graduated dial. One revolution of the pointer represents a variation in length of the stop of four thousandth of an inch. Screwed into the

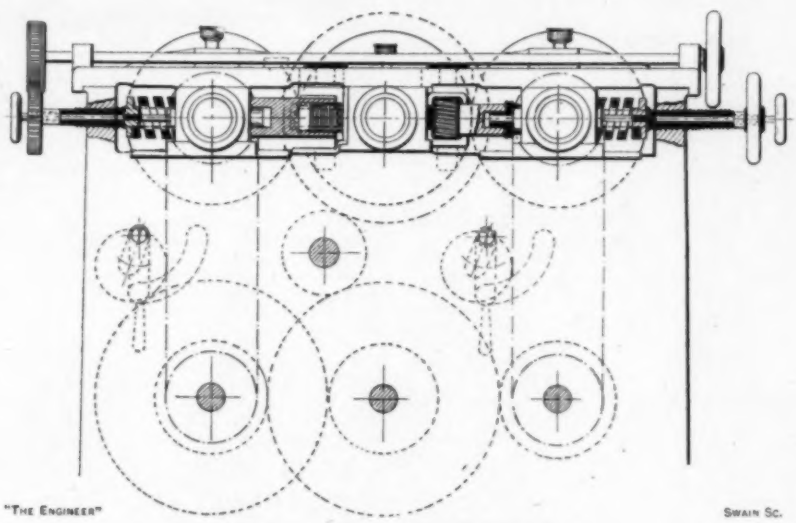


FIG. 15—CHAIN DRIVING GEAR—MARCHANT

housings, outside the roll bearings, there are spindles, which press the bearings up against the adjustable stops through the intervention of springs. The hand wheels of these spindles are plainly shown in Fig. 12, and it should, perhaps, be pointed out that the upper wheels operate the spindles of the back roll through long shafts and gears. With this arrangement, it will be seen that, once the foreman has set the adjustable stops, the attendant cannot interfere with the setting of the machine however hard he screws up the spindles, and there is no possibility of his overheating the rolls by rough treatment.

The rolls themselves have exceptionally large necks and run in bronze bushed bearings. These bushes are a press-fit in cast iron bearings, and can be easily renewed when worn. In the case illustrated in Fig. 12 the rolls are of chilled cast iron and arranged for water cooling. In this connection Mr. Marchant made some interesting remarks concerning water cooling, which indicate the extreme nicety with which paint grinding rolls must be adjusted. There is a natural tendency for the centre of the roll to heat up more than the ends, so that if it is truly parallel when cold it becomes barrel shaped on warming up on account of the greater expansion of the centre, and the water cooling should be used accordingly. If too much cooling water is used the centre of the roll is chilled, as the metal there is much thinner than at the ends, and the roll becomes hollow with the result that the grinding is very ineffective.

In the case of the machine shown in Fig. 12, the rolls are 12in. in diameter by 24in. long, and the upper pair is driven by a chain in the casing seen on the right. These two rolls do the rough grinding and deliver the paint at the back, to the triple rolls below, for finishing. For general purposes a single pass is sufficient, but for very fine work the paint may have to be passed through the machine a second time.

This firm makes a variety of other forms of roller-grinding mills, among which a rather uncommon type has six rolls, arranged as two sets of three directly above one another. The paint is fed between the front pair of the top set and is discharged to the lower deck at the back, so that the finished paint or ink comes out at the front. The arrangement has the merit of economising floor space, as compared with the tandem mill.

(To be continued)

Notes on the Effect of Wind on Power and Speed.*

By HUGH J. R. BILES, B.Sc., Associate Member.

THIS paper is an investigation of the effect of wind pressure on the horse-power and speed of different types of ships. The paper deals with effect of the wind pressure in increasing the resistance to motion, and also considers the extra resistance of the rudder when a large degree of helm angle has to be carried to counteract a wind on the bow or quarter. No attempt is made to consider the effect on resistance of rough water resulting from wind.

The procedure adopted has been to assume in each case the wind acting directly ahead, and to assume that the resulting pressure on the vessel can be expressed in the form $K A V^2$, where K is a constant, A is an area, and V is the speed of the vessel relatively to the wind. The value of the constant K adopted throughout has been 0·0043, and the areas have been measured in square feet, velocities in knots, and the resulting pressure in pounds. As a first approximation to the pressure on the superstructure it is usual to measure the transverse thwartship area of the vessel above the water line and use this for A in the formula above, it being assumed that the frictional air resistance is negligible. The constant K covers not only the pressure on the forward side of the surface, but also covers the effect of the rear suction on the surface exposed to the wind. The assumption that the whole of the thwartship area above the water line is exposed to a head pressure, similar to that on a plane advancing at right angles to the wind, is obviously not correct, for the portion of the vessel between the water line and the weather deck is of easy form, and it is obvious that the resistance of this portion of the above-water structure is usually almost entirely frictional, and is very small in comparison with the head resistance of a plane whose area is the same as the midship area of the vessel between the water line and the weather deck. On the other hand, when there is discontinuity in the superstructures, and a fair distance between these discontinuous portions, the wind will exert its full force, not only on the foremost superstructure, but on the ones abaft it which seem to be masked by the leading superstructure. Moreover, if the wind be a few degrees on the bow, then it will exert some effect on discontinuous superstructures, however close together they may be.

The resistance due to air pressure has been estimated for three vessels—one a 10-knot 400ft. cargo vessel of about 8000 tons deadweight, of the poop, long bridge and forecastle type; the second a 20-knot passenger liner of about 650ft. length; and the third a 20-knot cross-Channel steamer of about 320ft. length. Before giving the results of these estimates of wind pressure, it will be as well to outline how the calculation has been made.

(1) *Cargo Steamer.*—The forecastle has been taken as having a rear suction effect only and no pressure effect. This is accounted for by taking half the area of the after end of the forecastle instead of the whole area. The bridge space has been taken as having the full pressure and suction effect. In the case of the poop, the area of the fore end of the poop has been multiplied by three-fourths, to represent full pressure on the front of the poop, and a suction effect on the after end of the poop equal to half that of a flat surface. None of the houses on the bridge deck in any way mask each other, and they have been taken in a straightforward way. The funnel effect has been taken as equal to half that of a rectangular-shaped funnel. Frictional resistance was also estimated and found to be about 3 per cent. of the head resistance, and an addition of 2 per cent. was also allowed for fittings, viz., deck machinery, ventilators, rigging, rails, boats, skylights, &c. and 2 per cent. allowed for air eddies round the counter of the vessel.

(2) *Passenger Liner.*—A similar procedure has been adopted in this case, the only difference in the results being that as most of the superstructures and houses were continuous, or with very small gaps between them, the forward superstructures were in general the only ones that were reckoned as acted upon by the full force of the wind. The funnels were treated in exactly the same way as the cargo vessel, except that there was a sufficient interval between the funnels to allow the full pressure acting on all of them. In this case the frictional air resistance was found to be about 4 per cent. of the remainder. Eddies round the stern were estimated at 2½ per cent. and deck fittings at 2½ per cent.

(3) *Cross-Channel Steamer.*—The method of estimating was similar to the two previous cases. The frictional resistance in this case was estimated to be 3½ per cent. of the total, but owing to a very square stern, the estimate for the stern eddies resulted in an addition of 6½ per cent. to the total; 2½ per cent. was again added for the resistance of fittings, &c.

TABLE I.—(1) *Cargo Vessel. Air Resistance due to Wind of Velocity V relatively to Ship.*

V, knots.	Resistance, lb.	Per cent.	Air resistance / Naked resistance at 10 knots
5	207		0·8
10	829		3·1
15	1,870		7·0
20	3,315		12·3
25	5,180		19·25
30	7,450		27·7
35	10,150		37·7
40	13,260		49·3
50	20,700		77·0
60	29,900		111·0

TABLE II.—(2) *Liner. Air Resistance due to Wind of Velocity V relatively to Ship.*

V, knots.	Resistance, lb.	Per cent.	Air resistance / Naked resistance at 20 knots
5	385		0·2
10	1,540		0·8
15	3,460		1·8
20	6,170		3·25
25	9,640		5·1
30	13,870		7·3
35	18,900		10·0
40	24,700		13·1
50	38,550		20·4
60	55,500		29·4
70	75,600		40·0

TABLE III.—(3) *Cross-Channel Steamer. Air Resistance due to Wind of Velocity V relatively to Ship.*

V, knots.	Resistance, lb.	Per cent.	Air resistance / Naked resistance at 20 knots
5	114		0·25
10	455		1·0
15	1,024		2·3
20	1,820		4·1
25	2,840		6·35
30	4,090		9·15
35	5,575		12·5
40	7,280		16·3
50	11,380		25·4
60	16,380		36·6

In Tables I., II. and III. are given for the three vessels the estimated resistance in pounds due to wind pressure corresponding to various relative speeds of wind and vessel. In addition, a column is given which shows the percentage that this air resistance bears to the naked resistance at load draught of the ship, at 10 knots in the case of the cargo vessel and at 20 knots in the cases of the two other vessels. As an example, it will be seen from Table I. that if there is a 20-knot head wind blowing, then the relative speed of ship to wind will be 30 knots; the resistance in pounds will be 7450 lb., and the percentage of this to the naked resistance of the cargo vessel at 10 knots will be 27·7.

It will be noticed that the effect of wind is to increase the total resistance of the ship by a greater percentage in the case of the cargo vessel than in either of the other two cases. This is principally due to the fact that the resistance of the cargo vessel is small compared to the surface exposed to the wind. For instance, the thwartship area above the load water line of the cargo vessel in case (1) is 1685 square feet, as against 5270 square feet in the case of the liner, and 2100 square feet in the case of the cross-Channel steamer. The corresponding resistances are: 27,000 lb. for the cargo vessel at 10 knots, 189,000 lb. for the liner, and 45,000 lb. for the cross-Channel steamer at 20 knots. Moreover, the superstructures in the liner and cross-Channel steamer mask each other much better than in the case of the cargo vessel.

If the wind is on the bow it is not uncommon for quite large angles of helm to be required to keep the vessel on her course. The following estimates have been made from the results of model experiments on rudders, and the estimates give the added resistance due to helm angles of 10 deg. and 15 deg. The figures are based principally on Messrs. Baker and Bottomley's papers on rudders behind single-screw and twin-screw vessels, and on Mr. Denny's paper on spade rudders.

In the case of the cargo vessel, the formula used in calculating the normal pressure on the rudder is the one given by Mr. Bottomley in the paper he read this year before the Institution of Engineers and Shipbuilders in Scotland. This is—

$$P \text{ normal} = K A^{1.94} V^{1.95}$$

at 10 deg. $K = 0{\cdot}55$

15 deg. $K = 0{\cdot}78$

From this formula the pressure on the rudder of this vessel with 10 deg. of helm would represent an increase of 4·35 per cent. to the naked resistance at 10 knots, and with 15 deg. helm an increase of 9·35 per cent. The ratio of area of rudder for this ship to length multiplied by draught is as 1 : 70.

In the case of the liner the rudder pressures were calculated from the results of Mr. Bottomley's 1924 paper to the Institution of Engineers and Shipbuilders in Scotland. These are for a vessel of 0·76 prismatic coefficient, and it is probable that the actual pressures for this liner would be higher as she was a good deal finer than Mr. Bottomley's form. One of Mr. Bottomley's future papers will probably clear this up. The calculated results show that at 10 deg. helm the naked resistance at 20 knots is increased by 1·6 per cent. and at 15 deg. by 3·7 per cent.

In the case of the cross-Channel steamer the estimates of rudder resistance were made from Mr. Maurice Denny's paper on spade rudders—"Trans.," I.N.A., 1920. At 10 deg. helm the resistance is increased by 2 per cent. and at 15 deg. by 3 per cent.

It will be seen, then, that the increase of resistance due

* Read at the Spring Meetings of the Institution of Naval Architects, April 8th, 1927.

to direct wind effect and rudder is most serious in the case of the cargo vessel.

It is not always realised to what an extent a wind can upset measured-mile trial results. An example may best illustrate this. Referring to Table I., which gives the wind pressure results for the cargo vessel, it will be seen that if the vessel meets a 20-knot wind when she is herself doing 10 knots, the resistance due to a relative wind speed of 30 knots will be increased by 27·7 per cent. On the return run, the relative wind speed will be 10 knots following, and the resistance will be decreased by 3·1 per cent. That is to say, that for a pair of runs at 10 knots each way the mean increase of resistance due to wind pressure will be $\frac{27{\cdot}7 - 3{\cdot}1}{2} = 12{\cdot}3$ per cent. It will be seen from Table I. that if there had been no wind on the mile the increase of resistance at 10 knots would have been only 3·1 per cent., a difference of 9·2 per cent. That is to say, that if this cargo vessel were run on the mile on a day when there was a 20-knot wind blowing down the mile, the mean resistance and horse-power for a pair of runs would be 9·2 per cent. higher, due to a greater wind pressure than on a calm day. As the wind speed rises, so this percentage will rise.

If the wind is not directly down the mile, but is in such a direction that on one run it is a little on the bow, it will have the effect of increasing the wind pressure resistance, due to the additional resistance of parts of the superstructure previously masked by the wind. In addition, a certain amount of helm will be required to counteract the tendency of the wind to turn the vessel off her course. It was shown above that with a helm angle of 10 deg. the resistance of the cargo vessel was increased by 4·35 per cent., due to extra rudder resistance. It is not unknown for this degree of helm to have to be carried to counteract the wind effect, so that it will be seen that for a cargo ship under fairly normal trial trip conditions the mean resistance and power for a pair of runs may be increased by 9·2 per cent., due to wind pressure plus 4·35 per cent. due to helm. On a bad day the results will be considerably worse.

Measured-mile trials have two main purposes; one is to satisfy the owner that he has got what he is paying for, and the other is to give the shipbuilder data on which he can make future estimates and designs. Margins of power have always to be provided to balance the fact that service conditions are always worse than trial ones, and no analysis of trial results will reduce the fact that from 20 to 25 per cent. margin over the trial power is required for service conditions.

Analysis of trial results is very necessary to check estimates of power and speed, to balance up theory with practice, and to compare performances of one form and propeller against others. This is the justification for suggesting that shipbuilders might take on the extra work on trial trips of noting wind velocities and directions, and helm angles, and estimating how much power they have thus lost. This will assist in the comparison of performances on a fine-weather basis, which is the only practicable one.

Goodwill in Industry.

We have received the following from the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen, with a request that we should publish it :—

"The Glasgow and West Scotland Association of Foremen Engineers and Draughtsmen has taken a step which, it is hoped, will eventually lead to a much-needed growth of goodwill between the several interests directly responsible for the efficiency of British industry. Of late there has been much talk of peace in industry based on goodwill, and many industrialists, including the rank and file, have come to the conclusion that the best scope for the exercise of goodwill is in the individual works. If it could be well established in each works, it would, the Association believes, soon spread to the whole of industry.

"Of goodwill there is already, it is admitted, large measure; but something more is deemed to be necessary. Effective knowledge as to how goodwill may be translated into practice is needed and, more than that, a sincere and active will steadily to promote it.

"The three partners in industry are Labour, Management, and Capital, and all, obviously, must pull together in one direction if the common purpose is to be achieved. While, however, the views of those representing Capital and Labour have been voiced in a general way, the opinions of Management have not been heard to any extent. Yet, the Association points out, Management stands midway, so to speak, between the other partners in a position which enables it to appreciate the common difficulties inside the works more clearly than either.

"An association of staff members and foremen like the Glasgow and West Scotland Association of Foremen Engineers and Draughtsmen is, therefore, it is claimed, in a favourable position to make practical suggestions of a helpful character. Accordingly, the Association proposes to investigate the whole question, and has appointed a strong Committee for the purpose, selected from amongst its own members and also from such outside sources as have actual experience of schemes already in operation in various works throughout the country.

"The Association is fully alive to the fact that welfare schemes, works committees, and similar organisations have been tried with varied success. It is not convinced, however, that these laudable efforts have in view exactly the object which it desires to attain. It proposes, however, to give full consideration in its investigation to all such schemes, the working of which it can obtain particulars.

"It is not, of course, intended to deal with such questions as affect collective bargaining, wages or hours; these are regarded as quite properly matters for the consideration of the employers' associations and the trade unions. Neither is it the intention to encroach on the subject of works management, that being regarded as a matter for individual firms. The intention is merely to ascertain whether, from the point of view of Management, recommendations are possible that will assist both employers' organisations and employees' organisations to bring about a better spirit in industry.

"The members of the Association believe that within the ambit of the existing organisation of the shipbuilding and engineering industries, some simple means are possible to effect better personal contact in individual works between the representatives of Capital, Management, and Labour. The discovery of such a means would tend, in a negative sense, they think, to remove causes of misunderstanding and consequent mistrust, and, in a positive sense, to cement all grades more closely together.

"The intention is to avoid merely sterile formulæ as distinct from what is really practicable, and the Committee's terms of reference will emphasise that the object is to investigate and suggest rather than to dictate a cut-and-dried solution.

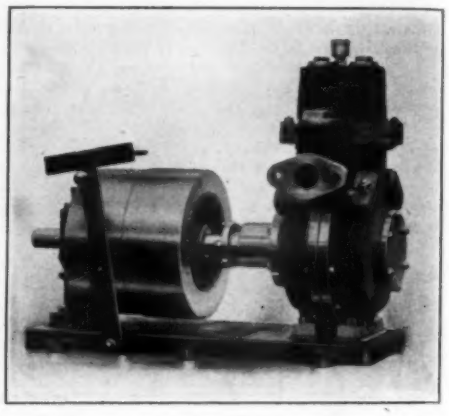
"It is hoped that any information or views sought by the Committee will be freely accorded, bearing in mind that the scope of the inquiry is strictly limited to what can be accomplished with the best chance of success in individual establishments. It is under consideration, it may be added, to offer prizes for papers on the subject to be read at the meetings of the Association. It is also proposed to issue, in due course, the Committee's conclusions in the form of a report.

"Any suggestion, idea or scheme based on works methods in successful operation will be welcomed by the Association from workmen, members of staff, firms or others interested in the subject. Communications should be addressed to the secretary, the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen, Elmbank-crescent, Glasgow."

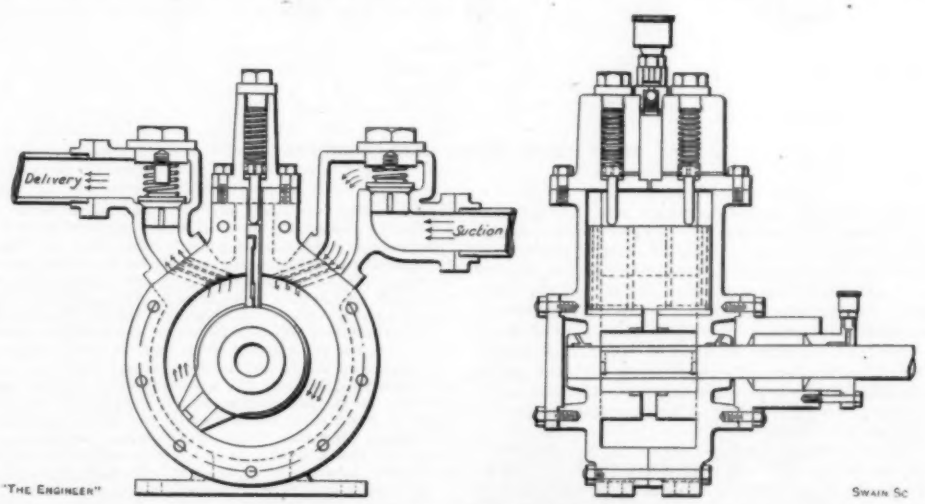
A New Rotary Pump.

We recently inspected, both at work and in the processes of manufacture, a form of rotary pump which, although it does not embody any very novel features, possesses several merits and certainly warrants the attention of those who require a compact pumping set in which extreme efficiency is not of paramount importance.

This pump, which is made by Mepstead and Co., of 101, Villiers-road, Willesden Green, London, is illustrated by the accompanying engravings, and is of that type in which a rotary piston works in a concentric chamber, with a movable abutment for separating the suction and delivery branches, which is lifted by the piston at every revolution. It possesses, however, some individual characteristics. Thus, as will be seen on reference to the line drawing, the rotary piston is formed as a "T" head on a thin disc keyed to the driving shaft and works in an annular space which is bounded on the outside by the casing and on the inside by bosses which extend from the two end cover plates. These bosses just touch the sides of the piston disc, so as to make a water-tight joint, but do not bear against it hard enough to produce any appreciable friction.



THE MEPSTEAD ROTARY PUMP



ARRANGEMENT OF THE MEPSTEAD ROTARY PUMP

The piston vane has sloping side faces which form tangents to the periphery of the supporting disc and is turned to conform to the curvature of the inside of the casing and the outside of the bosses. The surface bearing on the bosses is so wide that it is unnecessary to take any special precautions for ensuring a water-tight joint there, except in so far as that the faces are machined with appropriate accuracy; but the outer edge and the ends of the vane are provided with loose slips fixed in dovetail grooves and pressed outward by little coiled springs. These slips are so interlocked that they hold one another in place, but yet can be readily removed by hand.

The movable abutment or shutter valve must, of course, make a tight joint all round, and this is effected by making it in two thicknesses, with a space between the two parts. The delivery pressure is admitted to this space and consequently expands the shutter, so that it makes good contact with the sides of the slot in which it works. Contact with the piston vane is assured by a pair of springs and plungers arranged in a box on the top of the casing. This box also includes a chamber for holding grease to lubricate the moving parts. Below the Stauffer lubricator, which is used to feed this chamber, there is a non-return ball valve, so that the lubricator may be re-charged while the pump is at work. It is, however, necessary to put in a fresh charge only about once a day.

The pump which we studied at work was of the same general description as that outlined above, but it had two pumping chambers, with piston vanes set at 180 deg. working in parallel. It was pumping water and was working against a suction head of some 15ft. The discharge branch was fitted with a throttling valve and two independent pressure gauges. The throttle was screwed down until a steady pressure of 50 lb. per square inch was registered; but a higher pressure of some 60 lb. could be secured intermittently. The nominal capacity of the pump was 2000 gallons per hour, and although there were no convenient means of determining its actual output, it would appear from the speed at which it was running and the maker's assurances that such a delivery was being obtained. In these circumstances the power input, ignoring that necessary to run the line shafting, was 5½ ampères at 480 volts.

The wearing qualities of rotary pumps are always subject to criticism, so we asked Mr. Mepstead to dismantle a pump which had been running, so we were informed, in continuous service for three months, and inspected the rubbing faces carefully. The only indication of wear of any import that we could detect was a mark, less than "half a thousandth" deep on the shutter valve, where it rubbed on the piston disc; but that wear would not materially affect the tightness of the joint as the remaining length of the shutter is housed in slots in the bosses alongside the disc, and there the joint is made sideways by the spreading of the two leaves of the shutter as already described.

This pump is already being made in a variety of sizes at Willesden and it is intended to manufacture it on an extensive scale in the Midlands very shortly. It is, by the way, quite effective in pumping—that is to say, compressing-air.

CONTOURS FOR LOCOMOTIVE TIRES.

The British Engineering Standards Association has just issued a British Standard for Contours for Locomotive Tires for British Railways of 4ft. 8½in. gauge. These contours, together with the recommendations regarding their use, are based upon a memorandum and diagrams submitted jointly by the Association of Railway Locomotive Engineers and the Railway Engineers' Association, and have been approved by those two Associations. The contours have been designed for use with the B.S. Bull head rails and a 1¾in. flangeway between the check and running rails. The distance between the backs of the flanges is varied to suit the different thicknesses of the flanges, but the distance between the backs of the inner portions of the tires may be made to suit the rims of wheel centres. This has the following advantages :—

(1) Provision is made for maintaining constant the distance between backs of flanges as they become worn by coming in contact with check rails. (2) The new form of tire having any of the three contours can be so fixed on wheel centres that the flange is in the correct running position without altering the distance between rims of wheel centres.

Copies of this new Specification (No. 276, 1927) may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

Railway Matters.

THE death was announced, a few days ago, of Mr. George Deuchars, an Indian railway engineer of note, who was the Government Director of Indian Railways from 1919 to 1923.

THE Avonmouth Light Railway is a private line, 60 chains long, on the King Weston Estate, Bristol. It joins the Bristol Port and Pier Railway to the Great Western, and an Order has now been made transferring the property to the London, Midland and Scottish and the Great Western Railways, and authorising the completion of the scheme.

THE London and North-Eastern Company has sanctioned the construction of 259 passenger vehicles of various kinds. Four trains are to be composed of quintuple units on the articulated principle, and eight of quadruple units. There are to be three triple sets of restaurant cars. The all-electric kitchens are to be added to, as arrangements have been made for re-charging facilities at various centres.

AT the recent annual meeting of the Underground Electric Railways Company of London, the chairman, Lord Ashfield, said that when the company was formed in 1908 the population of London was 6,661,000, and that now it was 7,800,000, an increase of 17 per cent. The number of rides in trains, omnibuses and trams *per capita* was 169 per annum in 1902, but was now 494 a year, or an increase of 200 per cent.

THE project for the construction of an international bridge across the St. Lawrence at the Thousand Islands has fallen through, the Bill authorising it having been thrown out by the Dominion House of Commons. It was opposed by the Railway Department on the ground that when a terminus for ocean-going vessels was established on the Lower Lakes it would be necessary to build a railway bridge at that point and the two projects would conflict.

THE *Manchester Guardian* is responsible for the statement that the London, Midland and Scottish Railway Company has decided to adopt the Capprotti steam valve patent on its engines and a number of the latest type of express locomotives are to be fitted immediately. For several months, our contemporary states, the company has been experimenting with the valves on one of the expresses between Euston and Carlisle, and tests have proved highly successful. It is claimed that the invention will save coal, considerably reduce maintenance costs, and give greater power.

IN reporting on a fatal accident to a driver on the London and North-Eastern Railway at Carlisle, Mr. Main, of the Ministry of Transport, showed that the man had failed to carry out two of the rules laid down to protect him when going under locomotives to examine or oil the mechanism. The man who moved the engine, and so caused the fatal injuries to the driver, was also guilty of thoughtlessness. The inspecting officer urged the desirability of emphasising in a prominent manner the necessity for strict regard to the instructions, and added that the use of some indication by disc or clip to be placed on the regulator or reversing gear, was a feature worthy of consideration.

THE Ministry of Transport railway statistics for January have recently been published as a Stationery Office publication, price 2s. 6d. They show that, compared with January, 1926, the number of passenger journeys decreased by 8·3 per cent.; the receipts from passengers by 7·1 per cent.; and all passenger receipts by 5·5 per cent. Passenger train miles decreased 0·1 per cent. There was an increase in general merchandise traffic, but it was more than offset by a continuation of the fall in mineral traffic. The higher value of the former traffic caused an increase of 3·2 per cent. in the freight train receipts, although the tonnage was down by 0·05 per cent. There was an increase of 1·1 per cent. in the freight train mileage.

WE have on previous occasions referred to the rebuilding of the station at Newton Abbot on the Great Western Railway. The original station was built by Brunel for the South Devon Railway when it was opened in 1846. The three small platforms then in use have now been replaced by two island platforms, each 1375ft. in length, of which 570ft. are under cover. A separate bay line, 320ft. long, has been provided on the up side for the Moretonhampstead trains. There are two signal boxes, one of which contains 206 levers, and is the second largest mechanically-operated signal-box on the system. At a luncheon last Monday week to celebrate the formal opening, Viscount Churchill, the chairman of the company, said that the work had cost £100,000.

SPEAKING at the last monthly luncheon of the Middlesbrough Chamber of Commerce, Sir Ralph Wedgwood, the chief general manager of the London and North-Eastern Railway, took for his subject the future of British railways. He said that constant pressure was being put on railway companies to abolish inconvenient and sometimes dangerous level crossings by the substitution of expensive bridges. The railway companies simply could not afford to bear such expenditure. There was a great future for road transport in this country, and no one wished to curtail it, but at the same time development of road transport could be carried on under conditions which were unfavourable in an economic sense to railway transport. He suggested that the whole situation needed inquiry.

FROM a demonstration recently given by the Underground Company before the Press it would seem that it is proposed to have loud-speaking announcers in the compartments in order to advise passengers the name of the station at which they are about to arrive, and possibly to bid them "mind the doors." To many passengers the idea is far from pleasant and, judging by correspondence in *The Times*, they ask to be allowed to take care of themselves. What we suspect is behind the proposal is that the gatemen on the trains may then be dispensed with. If so, that will be a form of economy won at the expense of the comfort of the passengers. In view, further, of the alarm that would arise in the event of an accident to a train in the tubes, the desirability of there being more men on a train than the motorman and conductor is evident.

Notes and Memoranda.

THE possibilities of producing good lubricants from crude oils, that to-day are not being refined for this purpose, are promised by a series of tests conducted by the American Bureau of Mines. The results of the experimental work indicated that, for use in automotive equipment, lubricating oils need not be refined to as high degree as for use in turbines and similar machinery, and that considerable savings may therefore be made in present oil-refining processes.

THE American Society of Mechanical Engineers has accepted the custody of 17,500 dollars given by the Lincoln Electric Company, of Cleveland, Ohio, U.S.A., to be awarded, under the rules of the competition, to those contributing the best three papers disclosing new information that will tend to advance the art of arc welding. The purpose of this competition is to encourage improvements in the art of arc welding, the pointing out of new and wider applications of the process, or indicating advantages and economies to be gained by its use, as these latter will be the chief bases upon which the winning papers will be selected.

ONE of the most abundant and valuable resources of Nova Scotia is, according to the *Contract Record*, gypsum, of which the amount quarried since 1872 has been over 9,000,000 tons, practically all of which has been shipped to the United States. For the most part it has been exported in crude form, little manufacturing being done within the province, and yet it is from the preparation of gypsum for market use—its manufacture into plaster, gypsum board, tiles and blocks—that profits are accumulated. As it is now, these profits are being largely realised in the United States for the benefit of the citizens of that country, whereas were manufacture carried out in Nova Scotia, the people of that province would benefit.

ALTHOUGH the refining of oil produced by retorting Scottish shale has been carried on for many years, the refining of crude petroleum—all of which, except a trifling amount from one well in Derbyshire, is imported—has only recently become of importance in this country. The growth of the industry in recent years is indicated by the figures of imports of crude petroleum, which from one million gallons in 1913, 7¼ million gallons in 1919, and 4 million gallons in 1920 rose suddenly in 1921 to 101 million gallons—of which 90 million gallons were from Persia—and increased steadily to 569 million gallons in 1925, falling back slightly to 539 million gallons in 1926. Approximately, 1½ per cent. of the world's production in 1926 was refined in Great Britain.

CONSIDERABLE progress has been made in the manufacture and application of tungsten contacts to magnetos. It has been found, state Messrs. A. P. Young and L. Griffiths, in a paper on "The High-tension Magneto," that tungsten contact points produced by a special process will give excellent and thoroughly reliable service on certain types of magnetos in which the electro-magnetic factors have been properly adjusted. Experience has shown that if the magneto is designed to fulfil certain conditions required for the satisfactory operation of tungsten contacts, the life of those contacts is certainly equal to that of platinum-iridium. Whilst it would be unwise to predict that platinum-iridium will ultimately be superseded by tungsten for magneto contacts, it can be stated that tungsten is now largely employed, and its use is likely to be extended in the future.

A TELEVISION installation between New York and Washington was recently demonstrated in the presence of spectators over a distance of 250 miles. People in the laboratories of the Bell Telephone Company at New York heard and saw Mr. Herbert Hoover in Washington deliver a brief address. According to reports, his head and shoulders were seen in a dancing shadow composed of a myriad of small spots flickering upon a screen less distinct than an ordinary kinema picture. Mr. Hoover's facial expressions and movements were, however, quite visible. The installation was placed in an ordinary telephone booth, consisting of a small metal box, in which the telephone user was able to see the person with whom he was conversing. The first messages were sent by wire from Washington, and later a similar demonstration was given from Whippany, New Jersey.

THE production of slab zinc at zinc reduction plants in the United States in 1926 amounted to 659,221 short tons, valued at 98,883,000 dollars. The total comprised 611,991 tons of primary metal made from domestic ore; 6431 tons of primary metal made from Mexican ore; and 40,799 tons of re-distilled secondary metal. The production in 1926 exceeded the production in 1925 by 47,094 tons, or 8 per cent. The States having the largest output of primary metal were; Oklahoma, with 136,560 tons; Montana, with 111,596 tons; Illinois, with 110,381 tons; and Pennsylvania, with 100,538 tons. The remainder of the output, 159,347 tons, was smelted in Arkansas, Indiana, Kansas, Texas, and West Virginia. Rolled zinc produced in 1926 amounted to 172,668,298 lb., valued at 17,880,901 dollars, a gain of 21 per cent. in quantity and 23 per cent. in value of output, as compared with 1925.

THE use of natural gas for the purpose of lifting oil from deep oil wells is being studied at the Petroleum Experiment Station of the United States Bureau of Mines, Department of Commerce, at Bartlesville, Okla. Natural gas and compressed air have been used for lifting oil from shallow wells for many years, but these methods do not apply to deep wells. In this investigation it is planned to study the engineering principles of the application of natural gas to lifting oil in order to provide fundamental data for the design and operation of lifting equipment. A study of the use of gas lifts for increasing oil recovery in California oilfields is being made by the San Francisco field office of the Bureau of Mines, a great deal of data on the subject having been collected from operators. The subject of gas lifts in California at the present time is already of considerable importance, and will undoubtedly become more so as the deep wells in the Los Angeles basin cease flowing. Some of these wells have been drilled deeper than 6000ft.

Miscellanea.

PREPARATIONS are being made for the development of the Tambo tin mine, near Naboomspruit, Northern Transvaal. The lode is 37in. wide and is said to contain 3·18 per cent. of metallic tin.

THE Commission appointed to examine the preliminary project for the improvement of the port of Saint Nazaire in order to enable the port to receive the biggest naval vessels has approved the project with certain modifications.

H.M.S. NELSON, Britain's most powerful battleship, has been completed by Sir W. G. Armstrong, Whitworth and Co., Ltd., and will leave the Tyne to-day—Friday—for trials and docking at Portsmouth, afterwards returning to the Tyne for finishing touches.

A NEW high-power wireless broadcast station has been opened at Stuttgart-Degerloch, Germany, operating on 379·7 m. It is audible all over Europe, and it is expected that American set owners will pick it up occasionally when natural conditions are best for receiving.

A NEW treatment plant, costing about £5000, has just been completed at the Springvale lead mine at Galena, on the Northampton mineral field, Western Australia. The plant comprises a rock breaker, rolls, May jigs and Wilfley tables, and will treat about 700 tons a month with a single shift.

IT is announced that Baldwins, Ltd., intends to erect by-products works near the Ton Philip Colliery, and will experiment on a new method of low-temperature carbonisation. The plant will be capable of dealing with 500 tons of coal per day. Another extensive by-product works is to be built either in Bridgend or Briton Ferry by the United and Amalgamated Anthracite Companies.

THE Austrian Government is planning extensive reconstruction of the whole network of State highways in Austria, the total length of which amounts to some 2300 miles. The estimated cost of the scheme is 150,000,000 schillings, nearly £4,500,000. The necessary money for the reconstruction will be provided by the issue of short-term highways loans. The work is expected to take some years to complete.

THE possibility of a new steamship route to the Continent, which has been before the public for some time, will, from May 15th, be an accomplished fact. The steamers will be run by the Angleterre-Lorraine-Alsace Company, and the London, Midland and Scottish Company have arranged to run restaurant express services from the principal cities and towns on their system in connection with these services.

THE tuning-in of the first of the three 3-mile long aerials of the new Transatlantic telephone receiving station at Kemback, near Cupar, Fife, is now complete. Daily messages from the United States are received by the staff, which includes several American experts; reception is satisfactory, and the tuning of the other aerials will soon be complete. The three aerials radiate towards Denham, St. Andrews, and Pitscottie.

THE Department of Scientific and Industrial Research has appointed a committee to deal with the physical and chemical survey of the coalfields of Durham and Northumberland. The composition of the committee is as follows:—Mr. A. Kirkup, Dr. H. Peile, Mr. G. Raw, Mr. S. Bates, Major H. S. Streatfeild, Mr. R. Warham, Colonel W. C. Blackett, Professor H. V. A. Briscoe, Dr. J. T. Dunn, Professor G. Hickling, Professor G. Poole, Mr. R. G. Carruthers, Dr. C. H. Lander (ex-officio), Mr. F. S. Sinnatt (ex-officio).

THE Sydney Water, Sewerage and Drainage Board has placed a contract with the Australian Wood Pipe Company, Ltd., Lane Cove, N.S.W., for the manufacture, supply, delivery and laying of approximately 11¼ miles of 54in., 46in. and 44in. wood stave pipes, totalling about £140,000. The pipe line is to be laid from the upper canal to Pipe Head and Potts Hill reservoirs, and is to be completed within eight months. This main will deliver approximately 51,680,000 gallons per day, thereby increasing the present capacity by about 50 per cent.

THE characteristics of wireless waves 10 miles aloft are to be tested by French scientists. Aeronautical experts of the French Army have arranged to send up a small balloon which will carry with it a very light radio set that will automatically send out signals. From a like set, signals will be sent at the same time from the ground. The signals from both sources will be carefully recorded and studied. From the experiment it is hoped to obtain information regarding the effect of atmospheric conditions on wireless waves that will aid both aviation and wireless.

LOW-TEMPERATURE carbonisation of coal on a large commercial scale is, according to the *Chemical Trade Journal*, proposed for Canada. A syndicate, headed by Mr. Morgan J. O'Brien, is applying to Parliament for a Federal charter for a 3,000,000-dollar corporation. Plans are said to be practically complete for the construction of three 1000-ton per day plants, one to be in Ottawa and two in Western Ontario. These plants would be operated by subsidiary companies, and steps are being taken for the organisation of other subsidiary companies to operate plants in Montreal and Quebec. The proposal is to carbonise Canadian slack coal by the low-temperature process which has been made commercially successful in England.

TENDERS are being invited by the Melbourne and Metropolitan Board of Works for the construction of the largest reservoir of its water supply system, which is to be formed at Silvan, about three and a-half miles from Evelyn, on the Warburton line, by an earthen embankment, about 2100ft. in length and 136½ft. in height, which will make it the highest earthen embankment in Australia. Its concrete core wall is of cellular construction, and has been designed with a view to intercepting in the cellular portion of the wall any leakage which might penetrate the embankment and core wall, and conveying the leakage through the medium of the cellular construction to a drainage gallery which will be established at the base of the concrete core wall, and practically form end to end of the embankment.

EXPERIMENTAL BEET SUGAR FACTORY AT EYNSHAM

DESIGNED BY THE INSTITUTE OF AGRICULTURAL ENGINEERING, UNIVERSITY OF OXFORD

(*For description see page 431*)

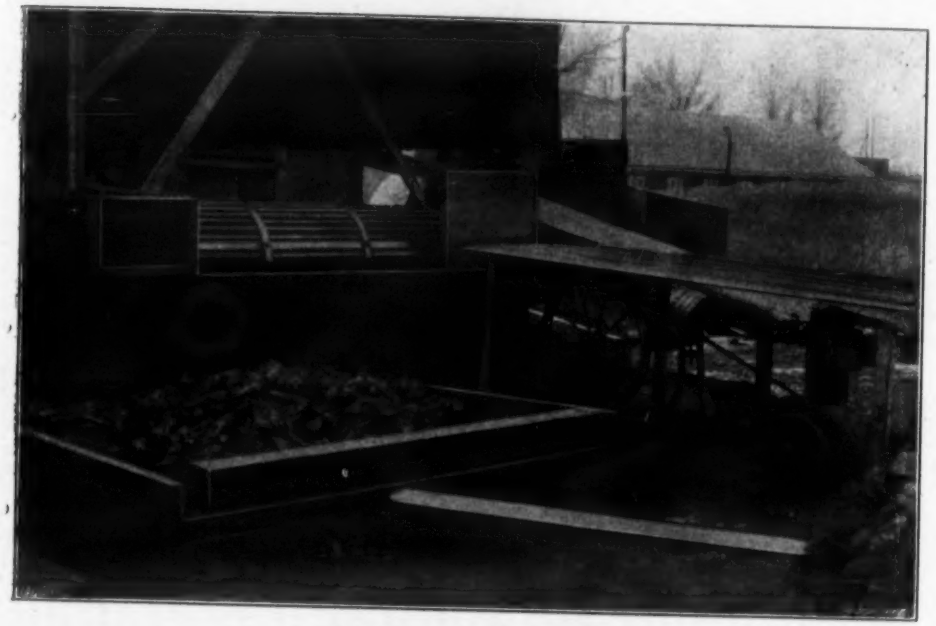


FIG. 8—THE RAW BEET WASHER

FIG. 9—FEEDING END OF THE BEET DRYER

FIG. 10—DELIVERY END OF THE BEET DRYER

FIG. 11—BAGGING THE DRIED COSSETTES

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DEATH.

On April 16th, Captain REGINALD JOHN WALLIS-JONES, O.B.E., T.D., M. Inst. C.E., M.I.E.E., of 5, Fitzjohn's Mansions Netherhall Gardens, Hampstead, N.W. 3.

THE ENGINEER.

APRIL 22, 1927.

A Projected Battleship for Coast Defence.

THE German naval authorities are at present studying a problem of great technical interest and no little difficulty. It concerns the design of ships which are urgently needed to replace the antiquated battleships that comprise the existing battle squadron of the "Reichs-Flotte." These latter belong to the "Braunschweig" and "Deutchland" classes, dating from 1903–06, and therefore entirely obsolete. They are deficient both in gun power—each mounting only four 11in. guns of a very old model—and protection; their present speed is low, and structure and machinery have so deteriorated that it is no longer considered worth while to spend any large sum for repairs. Such value as these ships possess is mainly relative; that is, they serve in some measure to preserve the equilibrium in the Baltic, where the Russian Soviet Navy, despite its notorious inefficiency, still makes a formidable parade on paper. Were Germany to discard her battleships, she would have to surrender the control of the Baltic into Russian hands, and that, for obvious reasons, she has no intention of doing. Nevertheless, as the old ships are now approaching the extreme limit of useful service, it has become imperative to replace them. This would be simple enough were it not that the design of future German warships is subject to severe restriction under the Treaty of Versailles. The maximum displacement permitted for new armoured vessels is 10,000 tons. As the Treaty apparently does not define the meaning of "displacement" in this sense, the Germans argue with some show of justice that it should be taken as signifying the "standard" figure established by the Washington Covenant, *i.e.*, the weight of the ship as completed for sea, but exclusive of fuel and reserve feed water. From the German angle of view, this is a point of capital importance, for the addition of 2000 or 3000 tons to the full-load displacement of a small battleship might make all the difference between success and failure in the case of a new design. Without attempting to prejudge the issue, we are of opinion that Germany's claim to interpret the 10,000-ton limit as "standard" displacement should receive sympathetic consideration.

Be that as it may, the question has passed from the academic to the practical stage by the reported decision of the German Ministry of Defence to resume the construction of armoured ships at an early date. According to an authoritative article in the *Vossische Zeitung*, the general features of the projected type have been under discussion for some time past. Political and strategic requirements call for a vessel capable of engaging without undue risk any capital ship likely to be encountered in the waters of Northern Europe, where the Russian Dreadnoughts, Paris Commune and Marat, of 23,370 tons, a nominal speed of 23 knots, and a main armament of twelve 12in. guns, are at present the most formidable units. Artillery power is therefore an essential feature of the design, and protection is also of great importance. On this latter point the *Vossische Zeitung* writes: "Protective armour, which was over-estimated in the past, will give place to modern cellular construction, triple bottoms and longitudinal bulkheads; only the really vital parts of the ship—*i.e.*, machinery spaces and gun positions—will have armour plating. As for complete water-line protection, that can be dispensed with; far more important is it to have improved protection for the magazines, in view of experience at Jutland." With regard to propulsion, steam machinery of any description is rejected on the score of excessive weight and space. Since the new vessel will not be expected to operate on the high seas, but is designed mainly for coastal service, it need have neither great speed nor a wide radius of action, Internal combustion engines are therefore favoured, and will probably be adopted. A comparatively small and compact Diesel plant would suffice for the moderate speed that is aimed at, and oil stowage for an endurance of 2500 knots is held to be adequate. No funnels are provided, and both freeboard and superstructure have been cut down to the minimum consistent with seaworthiness. As will be seen, the ship projected has many attributes of the monitor, of which it is, in effect, an up-to-date development. The question of armament has not yet been finally decided. While, on the one hand, guns of 16in. bore are favoured in some quarters, in order to give the new ships a calibre equality with the latest foreign battleships, the consensus of opinion favours lighter weapons, preferably the 14in. 50-calibre mark, which was to have been installed in the unfinished battle cruisers —"Von Spee" class—of the war programme. Emphasis is laid on the reputed fact that Krupp guns are considerably lighter than foreign pieces of corresponding calibre, and at the same time are equal, if not superior, in ballistic qualities. In this connection it is undeniable that the German 12in. and 11in. pieces in action at Jutland proved to be far more powerful than had been suspected. It is estimated that, on a displacement of 11,500 tons—equivalent to the "standard" figure of 10,000 tons—it would be possible to mount eight 14in. guns. This would represent about 30 per cent. of the total displacement, a percentage abnormal in a ship of conventional design, but regarded as permissible in the case of the ship under review, owing to the very moderate weight of machinery and the ample lines provided. An alternative suggestion of six 15in. 45-calibre guns, such as were mounted in the Bayern and Baden, has been rejected on the grounds that it would involve too great a reduction of either bow or stern fire. It is of interest to observe that German naval experts are almost unanimously opposed to the triple turret, the theoretical objections to which, they pertinently remind us, have yet to be disproved by the test of actual experience. This particular question was raised by the suggestion of mounting six 15in. or 16in. guns in triple turrets, which was declined both for technical reasons and because "two turrets would not make enough of an impression even on possible Baltic adversaries of the Germany Navy."

In view of the gunnery records of the late war, it may reasonably be assumed that one ship armed with eight 14in. guns might engage another mounting eight 15in. or even 16in., without necessarily suffering defeat, especially if the former offered a smaller area of target and was less vulnerable to blows in a vital part than her opponent. Thus the projected German vessel, which is unofficially styled the Ersatz Braunschweig, would not only be demonstrably superior in fighting power to the 12in. gun Russian Dreadnoughts, themselves past their prime, but need not shrink an artillery duel with ocean-going battleships of the latest type, provided the combat took place in waters where seaworthiness was a consideration of minor importance. The design of ships for any navy must perforce be determined in large measure by the venue of operations. Criticisms of the diminutive battleships which the minor naval Powers of Europe have seen fit to build usually ignore the

peculiar strategic conditions which governed their design. A great super-Dreadnought, all powerful on the broad ocean, would be reduced to impotence in shoal water, and might even be subjected to the humiliation of bombardment from the high-angle guns of a puny antagonist to which it could not reply. All things considered, therefore, the reported German decision to build ships reminiscent of the coast defence ironclads of a bygone age has much to commend it. They will enable Germany to hold her own in the Baltic, and even, if it be necessary, to deploy in the North Sea a squadron of sufficient power to deter attack by any save a hostile fleet of the first magnitude. A criticism of the technical features of the design must be postponed until official details are available. At this juncture we need only point out that recent years have witnessed many improvements in the science of ship construction, marine engineering, and naval ordnance, all of which tend to facilitate the design of future warships, whether large or small. Twenty years ago it would have been impossible to build a small coast service armour-clad which even under the most favourable conditions could have stood up to a contemporary battleship of the first rank. To-day, however, as will be seen from the foregoing sketch of the projected German design, a vessel of very modest tonnage may be endowed with tactical qualities of a high order, provided that the inevitable sacrifice of speed be accepted. In reviewing current German discussions on naval design we are impressed with the cardinal importance attached to gun power. The submarine occupies a wholly subordinate place in future naval operations, as viewed through German spectacles, and although this fact may be due in part to the mental processes evoked by the Versailles Treaty, we are rather inclined to think that it reflects the interpretation by the logical German mind of the lessons of the late war at sea, in which the supremacy of the artillery weapon in ship to ship duels was demonstrated beyond argument.

A New Method of Manufacturing Beet Sugar.

In the manufacture of beet sugar, as ordinarily carried out by the diffusion process, it is necessary to deal with the roots within a limited time after they have been dug. Generally speaking, the period, or "campaign" as it is called, during which it is possible to operate with maximum efficiency is limited to from ninety to a hundred days. If allowed to remain too long untreated the beets tend to sprout or become rotten and there is a loss of sugar. It is, obviously, a drawback of the process that the factory must remain idle for more than two-thirds of the year, and for a long time now endeavours have been made to discover some method by means of which the roots might be dried satisfactorily on a commercial scale. It was argued that, if the beet could be dried without injury, and without loss of sugar, then it would be possible to employ smaller factories for a given output, since they could be kept in operation throughout the year, which, for obvious reasons, would be advantageous. It was argued, too, that if a dried material were being treated the consequences of a breakdown in the sugar manufacturing machinery would, nearly certainly, be much less serious than it would be under present conditions. There is the further advantage that, could the beet be dried near where it was produced, the cost of conveying it to the sugar factory would be considerably reduced. As things are, a comparatively small breakdown may easily wipe out the profits of a whole season. Until quite recently, however, the efforts of those trying to discover a process which would dry beet successfully on a large scale had not met with any tangible result. There is no difficulty in drying beet under laboratory conditions, but, when it came to doing it on an economical commercial basis, difficulties, which up till eighteen months or so ago appeared to be insuperable, were encountered. It is pleasing to be able to put on record that those difficulties were overcome, and overcome by investigators in this country where the manufacture of beet sugar was only begun at a comparatively recent date.

In another column we give an account of the research work that has been carried out for the Ministry of Agriculture and Fisheries by the Institute of Agricultural Engineering at Oxford. It is unnecessary, therefore, here to say more than that a method of drying beet, which is in every way satisfactory, has been devised, and further, that a method of extracting the sugar from the dried beet, which gives better results than any before achieved, has been worked out. The system of drying developed is extraordinarily simple and easy to operate, and the dried cossettes produced by it, in addition to remaining unaltered for an indefinite period—at any rate for a year—exhibit no caramelisation and only a negligible percentage of invert sugar. The original idea with which it was sought to dry the beet was, as has been said, that the process of manufacturing sugar might be spread over a longer period than the three months or so of the campaign. As a matter of fact, a further advantage attaches to the new desiccation system of treatment which may or may not have been anticipated. When the dried cossettes are treated with warm water a syrup of more than three times the concentration as compared with the juice from the final vessel of a battery of diffusers in the ordinary process is obtained. The syrup from dried cossettes contains, in fact, very nearly as much sugar as does the syrup, which in the diffusion process is delivered from the evaporators. Consequently, with the desiccation process, evaporators, with their costly accessories and operation, may be omitted, and, furthermore, the syrup from dried cossettes is so much more readily purified or defecated than is the juice from diffusers that the processes of double carbonitation, with their accompanying lime kilns and other necessary appurtenances, are not required. In their stead there is one treatment in one vessel, and a reduction in the equipment of tanks, pumping, piping, &c., is effected. Finally, fewer filters are required for a given output. It is true that the desiccation process requires rather more fuel than does the diffusion process, but the extra expenditure on that item is much more than made up for by savings in other directions. The discoveries made by the Institute at its factory at Eynsham will, in our opinion, have a considerable influence on the beet sugar industry. Their immediate result will be to cheapen manufacture, and as much in connection with them has been patented by the University of Oxford, which is under the *ægis* of the Ministry of Agriculture, and as better terms for licences are likely to be given to home manufacturers than to foreign competitors, this country should certainly derive no little benefit from them. At the present time beet sugar cannot be made in Great Britain at a cost sufficiently low to compete on level terms with continental beet sugar, so that, to keep the industry alive, it is necessary for the Government to subsidise it. At the moment, we believe, it costs not less than, say, from £12 to £14 per ton to manufacture beet sugar by the diffusion process in this country, that figure leaving out of account the price of the roots. Taking the latter at £20 per ton of sugar produced, which is, we understand, the accepted figure, taking the extraction at 13·25 per cent. of sugar, the total cost of production reaches, say, from £32 to £34 per ton. Continental granulated beet sugar, which is comparable with the product of this country, is at the present time being sold here at £1 9s. 6d. to £1 10s. 6d. per hundredweight, or from £29 10s. to £30 10s.—say, an average of £30—per ton, duty paid. Hence the home-made article cannot compete with the continental product even when the latter has paid duty.

The cost of producing sugar varies, naturally, with the size of the factory in which it is made. The Institute, as we explain in the article already referred to, has made some careful calculations as to the cost of working the process which it has perfected. It has submitted those calculations to authorities fully capable of judging their accuracy, and it has been assured that its figures err, if anything, on the low side. In support of that finding it may be said that, actually, the Institute has, even with the quite small plant at its disposal, produced sugar of excellent quality at a figure substantially less than those which, it asserts, are economically possible with factories of the much larger sizes that it has chosen as examples. It maintains that, with the new process, it will be possible, in a plant designed to treat 25,000 tons of fresh beet per annum, to produce sugar for about £7 5s. per ton, and in a 100,000-ton plant for about £5 14s. 5d. Those figures include overhead and every other charge saving the cost of beet. The total costs, including the beet, would therefore be £27 5s. and £25 14s. 5d. respectively for the two sizes of factory. At the present time the manufacturer of "white granulated sugar" in this country receives a subsidy under the Sugar Subsidy Act of 19s. 6d. per hundredweight, but he has to pay a duty of 7s. 4d. per hundredweight on all sugar produced, so that actually the net subsidy is 12s. 2d. per hundredweight, or £12 3s. 4d. per ton. The gross cost of producing sugar by the diffusion processs is £41 6s. 8d. per ton, made up of, say, £14 for manufacturing costs, £20 for the roots, and £7 6s. 8d. for the duty. Deducting the subsidy of £19 10s. the net cost is £21 16s. 8d., at which there is a substantial profit if the sugar be sold at £30 per ton—the average price of continental granulated sugar. With the Oxford, or desiccation, process, taking the figure for the 100,000-ton per annum factory, *i.e.*, £25 14s. 5d. per ton, the case is considerably better. With the excise duty of £7 6s. 8d. the cost becomes £33 1s. 1d. and, deducting the £19 10s. subsidy, the net cost works out at £13 11s. 1d. per ton, which would show a profit of £16 8s. 11d. were the product sold at £30. As things are, neither the diffusion nor the desiccation process could show a profit were the subsidy to be withdrawn and the duty maintained, but were the subsidy to be withdrawn and were the duty to be remitted, the desiccation process could still show a profit of £4 5s. 7d. per ton, whereas the diffusion process would suffer a loss of £2 to £4 per ton. Granted, therefore, that the Institute's figures are right, which we see no reason to doubt, the new process is likely to cause something like a revolution in the beet sugar industry.

Obituary.

MR. H. T. CHAPMAN.

Members of the Institution of Mechanical Engineers will learn with great regret that Mr. Hemsley Theodore Chapman, one of the joint assistant secretaries, died on April 12th, following over a year of failing health. Mr. Chapman was born in 1863. In 1890 he was appointed to assist Mr. Alfred Bache, at that time secretary to the Institution, Mr. Chapman's chief duty being the editing of the "Proceedings." In 1896 Mr. Bache's health broke down, and it fell to Mr. Chapman to carry through to a conclusion the arrangements made for that year's summer meeting in Belfast. This task he completed with a success which earned for him the commendation of the Council. From that time onwards his chief responsibility continued to be the editing of the "Proceedings." In 1920 he was appointed one of the joint assistant secretaries under Brig.-General Magnus Mowat. Mr. Chapman was very methodical and businesslike in all his work. He took an active part in all the general work of the Institution, and was very popular with all the members who came into touch with him.

Institution of Mechanical Engineers.

NORTH-WESTERN BRANCH.

At a meeting of the North-Western Branch of the Institution of Mechanical Engineers, held in Manchester on Thursday, 7th inst., Lieut.-Colonel Kitson Clark, member of Council, presented his paper on "Internal Combustion Locomotives." There was a large attendance of members, and the author's *résumé* was followed by a discussion in which a number of members took part. Mr. Harold F. Massey, chairman, said that the author had put the paper forward at an early stage, but it was to be hoped that he would not only benefit others, but would obtain very considerable benefit himself from the discussion.

Mr. G. E. Windeler said that the author and his firm were to be congratulated on the courage they had shown in attempting to evolve a locomotive of increased efficiency. The Still system was already in use for marine work. Colonel Kitson Clark had referred to the question of the piston-rod, and his great pleasure in having only to deal with steam in the packing gland. At the same time, a great measure of success had attended the use of packing glands on internal combustion engines. It was interesting to note the effect that had been obtained by enlarging the diameter of the valves. The high M.E.P.'s that had been obtained showed that the oil had been usefully burnt, and that the oxygen had been properly absorbed.

Dr. Telford Petrie said that he was particularly glad to note that the solid-injection principle had been adopted, as that method, whilst still presenting difficulties, was at once the simplest and most direct way of forming the working substance of a heavy oil engine. There was, perhaps, too much tendency at present to try to create a suitable mixture by attempting to fill existing types of combustion chambers, and by controlling the movements of the air currents and of the oil jets inside such chambers. His experience had been that the oil spray came out of the very small holes in the nozzle at any given oil pressure in a shape and direction which was not controllable after it had left the nozzle. If one could build a combustion chamber round a group of such sprays, rather than attempt to fit the sprays into an existing combustion chamber, it was possible that more consistent results would follow than had been achieved in many cases in the past.

Mr. J. W. Smith said that he had seen the experi-

mental engine, and considered that there was a future for it. One of the difficulties, he thought, lay in the arrangement for transmitting the power of a spring-borne engine to the coupled wheels. With regard to the valves, there was a greater number than was customary on locomotives, but comparing them with a motor car, there was no reason to anticipate that they would not work on a locomotive.

Mr. A. H. Wareing, dealing with the steam gland on the piston-rod, asked whether any device was provided to prevent the possibility of oil leaking along the piston-rod.

Mr. Jackson said that the secret of the Diesel locomotive lay in the transmission gear. The introduction of the Still part cut out the transmission gear, and enabled the Diesel engine to operate without shocks. Comparisons had been made between the Kitson-Still engine and ordinary reciprocating locomotives, but it might have been better if Colonel Kitson Clark had dealt with the latest form of locomotive—the turbine locomotive.

Mr. R. C. Bond said that there was not much doubt that sooner or later they would have to consider alternative forms of locomotive power for railway working; but he felt that, unless engineers could produce some type of machine having certain inherent advantages of its own, and at the same time all the advantages of the steam locomotive, they would not have much hope of achieving success. Colonel Kitson Clark had shown them a most interesting curve of fuel cost, but there was the other side of the question to be considered. Could he say with any degree of certainty that the cost of upkeep would not be excessive, and that the time that the engine was in traffic would compare favourably with the time that one could keep a steam locomotive in traffic? He felt convinced that probably far greater loss accrued to a railway company through having locomotives standing in sheds out of traffic than was generally realised. By means of Professor Dalby's tractive diagram, the author had made comparisons with two classes of locomotive, and had shown that the Kitson-Still locomotive had certain advantages at speeds above 30 miles per hour. He would like to know the weight of each of those locomotives in comparison with the Kitson-Still locomotive, and their respective axle loads. He could not help feeling that, whether they were dealing with electric locomotives or turbine locomotives or any other type, people were not sufficiently clear in their basis of comparison. They showed curves which proved undoubtedly that their own particular locomotive was more efficient, but it was frequently found that they were comparing ancient steam locomotives with modern and highly specialised pieces of machinery.

Mr. A. T. J. Kersey said that he would like a little information regarding the steam indicator cards given in the paper. Were they obtained without any auxiliary oil being fed to the boiler? If that were not the case, what was the ordinary working pressure when working entirely on the Still principle? The pressure was apparently about 140 lb. in every case. Was that the pressure with which it was intended to work when working on the Still principle?

Mr. G. W. Bailey asked whether any trouble arose in connection with the lubrication of the cylinders, and also as a result of steam leakage from the steam side to the internal combustion engine side.

Mr. E. Johnson desired to know whether the driver would have improved facilities for observing the signals on the road, or whether his attention would be so much occupied that he would require a second man to watch the road.

Lieut.-Colonel Kitson Clark, in reply, said that he was not satisfied with the degree of combustion achieved. Sometimes it was surprisingly good, and then for some reason or other it was not quite what they wanted. With regard to the management of the engine, the boiler was extremely small, and the outlook was very much better than on any of the large engines at present in use. The engine was very easy to work. There would be two men on it. The second man did not have to trouble about firing. He was practically a duplicate of the driver. The engines which they had compared were the most modern types. The engine would run at 400 revolutions. It was true that the great cost of locomotives was their shed time. The most expensive shed time was incurred when a boiler was being taken out and a new boiler put in. Boilers had to be kept in stock, and they were very costly items. The boiler of the Kitson-Still engine was merely one long tube and would be a very cheap thing to keep in stock. The vacuum would be provided in the ordinary way with direct steam. The boiler could be employed for heating the train and for all the ancillary work one got with a steam locomotive. The turbine locomotive was an excellent thing, but it had condensers and other details which they at the present time were not contemplating. Certainly the reciprocating engine did not compare well with a turbine, but it looked very well when they came to pay the bill. The steam gland on the piston-rod was a well-known danger, and some people employed a long piston-rod in order to prevent the oil creeping back. That was a danger about which they knew, but they had not seen any sign of it, although, of course, they had not run a long time. The first cylinder liner was made of a special mixture. It had been taken out and examined, and had been found to look like a mirror. The surface was ideal. One point was worth emphasising. Every single function was applied at a central point in the engine, so that every function suffered from exactly the same amount of torsion in the connecting shafts, and every particle of oil had to travel through exactly the same lengths of pipe from the pumps. There would not be one second's lag in any of the items. All the power was put into the centre of mass, and that fact was going to be very important when it came to practical life on the open road.

Literature.

Masonry Structures. By F. P. SPALDING. Second edition, enlarged and revised by A. LINCOLN HYDE, Ph.B., M. Am. Soc. C.E., and E. P. ROBINSON, B.S. in C.E., M. Am. Soc. C.E. London: Chapman and Hall, Ltd. 1926. Price 25s. net.

THE many engineers who have accepted the first edition of this useful treatise as a standard work will be glad to learn that the purpose of the revisers as expressed in the preface to the present edition has been ". . . . to preserve the author's individuality and to adhere as closely as possible to his original plan. . . ." Since the possible scope of a treatise on "masonry structures" is many times that of a volume of moderate size, it is necessary to note what that plan was. The late author, who was Professor of Civil Engineering in the University of Missouri, stated in his preface to the first edition that the book was "designed to present, in a brief and systematic manner, the fundamental principles involved in the design and construction of masonry structures." He also described the book as ". . . an introduction to the subject . . ." and pointed out that the types selected for discussion were those which seemed best to illustrate the principles, no attempt having been made "to cover fully the details of all classes of masonry structures." The scope of the work is thus correctly indicated, except for the consideration that the last five words quoted above might have been, "any class of masonry structure."

Since the book is not descriptive of masonry structures, and does not treat of such matters as the choice of a type to suit the conditions, or the economics of construction, it has been possible in its 575 pages to deal adequately and very usefully with the design of simple structures and that of the elements of other structures, as well as to present, less thoroughly, some useful description and discussion of materials. The author's interpretation of the word "principles" is a liberal one, and the book is more than an introduction to the subject, for typical cases of design are presented very clearly and thoroughly, the author having a just sense of the extent to which description should, in certain cases, be somewhat elaborate. The fact that the treatment of design and construction is the dominant feature might not at once be apparent from a glance at the table of contents, but when it is realised that the chapter on reinforced concrete, which begins at page 187, is a study of forms, such as beams and columns, which are elements of structures, it will be evident that the treatment of materials, including types of masonry work, is relatively brief. Retaining walls, slab and girder spans, masonry arches and the several types of foundations, are dealt with in a very useful manner, the treatment of the subject of pile foundations being an excellent summary of the more important methods.

The short historical introduction is followed by a very well written chapter on "Cementing Materials," in which the general characters of limes and cements are lucidly described. As regards the matter relating to hydraulic limes, hydraulic cements, and pozzuolan, there is a failure to indicate the range of materials coming functionally under the term pozzuolan, nor is there any reference to the very great volume of masonry work which has been made with surki mortar. It must also be observed that the brief treatment of building stones is distinctly disappointing, in view of the interest which attaches to those qualities of well-defined kinds of stone, which render them specially suitable for certain purposes. Of necessity included in a work on masonry structures, and necessarily brief, the chapter on dams may be regarded as a good summary, except as regards multiple arch dams.

The calculations and descriptions relating to such elements or structures as retaining walls, other walls, arches, culverts, foundations, and the various forms which can be made with reinforced concrete, are excellently presented and suitably illustrated by diagrams and drawings, and the book is, it may be repeated, a very useful and unusually lucid treatise on the most important part of the subject indicated by the title.

BOOKS RECEIVED.

To America in Thirty-nine Days: Before Steamships Crossed the Atlantic. By J. Biggs. Kingham: The Village Press, Idbury. Price 3s. 6d. net.

Bewegungsfugen im Beton-und Eisenbetonbau. By Professor Dr.-Ing. A. Kleinlogel. Berlin: Wilhelm Ernst and Sohn, Wilhelmstrasse 90, W. 66. Price 17·50 marks.

The Study of Flame Movement. By O. C. de C. Ellis, being Paper No. 32 of the Safety in Mines Research Board of the Mines Department. London: H.M. Stationery Office. 1927. Price 1s. net.

Internal Combustion Locomotives.*

By Lieut.-Colonel E. KITSON CLARK.

(*Concluded from page 411.*)

HAVING reviewed the experimental work, the leading features of the actual locomotive design are next presented —Fig. 5.

TABLE I.—*Main Particulars of Locomotive.*

Internal combustion engine, eight-cyl., four-stroke cycle—	
Cylinders	13½in. dia. by 15½in. stroke
Gear ratio	1·878 to 1
Designed engine speed	450 r.p.m.
Locomotive speed at 450 r.p.m.	45 m.p.h.
Maximum I.H.P. on combustion only	1000
,, ,, available	1200
Starting tractive force	25,450 lb.
T.F. at 45 m.p.h. (assuming 80 per cent. overall mech. efficiency)	7000 lb.
Boiler and tanks—	
Heating surfaces—	
119 tubes, 1¾in. dia. outside by 9ft. long	490·6 sq. ft.
Fire-box	72·0 sq. ft.
Total evaporating surface	562·6 sq. ft.
Regenerating surface—	
36 tubes, 2¾in. dia. outside by 17ft. 4in.	448·7 sq. ft.
2 ,, 6¾in. ,, ,, 17ft. 4in.	59·0 sq. ft.
Total regenerative surface	507·7 sq. ft.
Fire-box volume	39 cu. ft.
Water capacity	1000 gallons
Fuel oil	400 gallons
Lubricating oil	85 gallons

Combustion Gear.—The engine is directly reversible, a sliding cam shaft being employed. The mechanism is of the scroll cam and excentric mounted rocker lever type, with a forward and backward cam to each valve. Stops are provided which cause the roller ends of the levers to clear their respective cams as the cam shaft slides from one position to another. These stops further ensure that both inlet and exhaust valves are lifted clear of their seats at the time, thereby effecting a pressure release during the process.

The valves of such a locomotive experience a certain relief in that the time of full load is not continuous, and that frequent stops intervening in the service constitute a less exacting demand than that made upon engines for marine or stationary work. Ready access to either valve is given, as the air valve is placed in a removable cage immediately below and in line with the exhaust valve, and the exhaust valve is withdrawn through the opening thus provided. Moreover, the exhaust valve seat is directly cooled.

Oil is supplied to the fuel jet body by a plunger pump operated by a timed cam and driven from the crank shaft by gearing. The fuel jet mechanism consists of a spring-loaded valve seating in a nose through which small holes are drilled. At every injection stroke the pump plunger builds up a pressure of the oil in the delivery pipes, so that it lifts the jet valve off its seat and forces its way through the small holes into the combustion space at high velocity, thereby obtaining atomisation—Fig. 6. The opening of the jet valve is dependent entirely on the timing of the pump cam. The length of injection period controls the variations in power, and the length is determined by the opening of a small valve in the delivery pipe line which is actuated by means of a trip gear connected with the pump rocking lever, Fig. 7. When this valve is opened the unwanted portion of the pump discharge returns to the fuel tank.

This system was selected because its well-known advantages seemed particularly applicable to locomotive work.

(*a*) If a jet valve leaks or a spring breaks, oil is only injected at the opportune time, all pressure being reduced to atmospheric at the end of injection by the opening of a spill valve.

(*b*) The fuel jet is free from mechanical control and operation.

(*c*) There are no air compressors, intercoolers, &c.

(*d*) The air supply is confined to that which is purposely admitted through the inlet valve, so that in case of jet trouble and chance excess of oil there is no excessive oxygen by which an unduly powerful explosion would be produced.

(Though not bearing on this argument, it may be noted that, owing to the permanently hot conditions of liner and cylinder head, unburnt oil is unlikely to accumulate, as at each stroke it will be vaporised and expelled.)

Pipes delivering oil to the jets from the pumps are all of equal lengths, thus symmetry of capacity produces equality of distribution to each cylinder. The fuel pumps are reversed by the same control as the combustion valve gear, and are similarly reversed by the sliding cam shaft and excentrically mounted rocker system.

Steam Gear.—The Hackworth principle is adopted for the steam valve gear. In this gear motion of the valve is derived from the extremity of a vertical lever, which is reciprocated by a single return crank on the end of the crank shaft. The fulcrum of the lever is supplied by a pin in a die block sliding between guides. As these guides are more or less inclined to the axis of reciprocation, the travel of the extremity of the lever is altered accordingly and the valve travel is correspondingly increased or reduced —an inclination of the guides by means of the reversing lever to the opposite side of the vertical axis changes the sense of the valve motion.

In full gear a cut-off of 75 per cent. is produced with a guide inclination of 30 deg.; and in this position, which occurs only at starting, the load on the slides is well below the capacity of the surfaces provided. In mid-gear a 6 per cent. cut-off is produced, which distribution accords with the amount of regenerated steam available. Due to the symmetrical position of the cylinders and the disposition of the crank only one set of gear is necessary for four cylinders, and another similar gear for the remaining four. The adjacent cylinders at one end act on cranks at 180 deg., and the complementary action of the valves is attained by inverting the steam and exhaust ports and valves. The two ends are similarly complements of one another. The gear lies completely inside the closed

* The Institution of Mechanical Engineers.

THE KITSON-STILL EIGHT-CYLINDER FOUR-STROKE LOCOMOTIVE

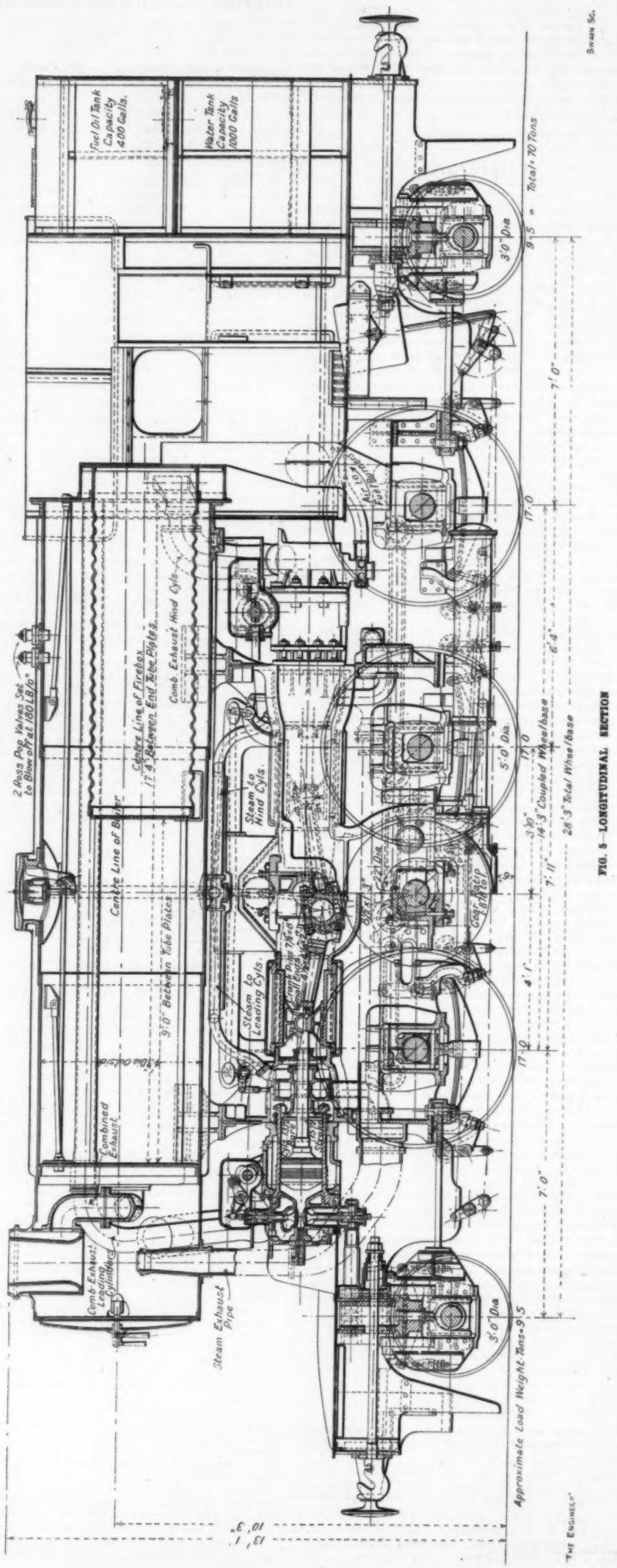


FIG. 8—LONGITUDINAL SECTION

entablature and forced lubrication is supplied to all its moving parts.

The boiler which supplies the steam is a simple structure. Its functions are to provide steam by oil firing for starting, to act as partner with the combustion cylinder jacket in the regeneration of steam, by absorbing the heat of the exhaust gases, and at the same time to act as a silencer—Fig. 8.

The primary evaporative surface consists of a corrugated flue forming the combustion chamber and a bank of tubes conveying the gases to the smoke-box as in accepted locomotive practice. This surface is in service at starting and during overload conditions. For the period of ordinary service, the main oil burner will be shut as the heat of the exhaust gas is relied upon to provide for losses due to radiation and recuperation of any pressure lost at starting. The service of the main burner is thus intermittent and a pilot burner is added. The latter is placed below the main burner and impinges on refractory material, which, being thus kept incandescent, provides the agent for igniting the main burner. Oil for these burners is passed through a heater at a pressure of 2½ lb. per square inch, and is carried and atomised by steam. (In the unusual circumstance of the locomotive being required to start from cold conditions away from any shed steam supply, a hand air pump and temporary lighting-up burner is provided to enable 5 lb. per square inch steam pressure to be raised, being the minimum on which the burners will work.)

The furnace back is entirely closed by a duct drawing air from below the platform through a cowl which provides for forward and backward running by a directional damper. When the main burner is shut off this duct is closed by the main damper and sufficient air for maintenance of the pilot burner is admitted through ventilators in the back of the duct directly under the hand of the operator. By this arrangement any fortuitous flash back from ignition of the main burner oil is muzzled in the duct and cold air cannot be drawn through the tubes to their injury.

The evaporative surface is to be distinguished from the regenerating surface. The latter receives the exhaust gases from the internal combustion. It is provided by a number of tubes connecting the extreme ends of the boiler. Exhausts of the front range of cylinders are passed back by two 6in. pipes through the right and left sides of the boiler respectively to manifolds at the rear end, whence they return to manifolds in the smoke-box through nests of small diameter tubes. The exhausts of the hind range of cylinders are passed *vid* the hind manifolds through separate nests of small tubes to the common smoke-box manifolds and are collected in a breeches pipe, and so taken to the chimney annulus. Thus, the exhausts do not interfere with each other. The collection into an annulus ensures that the pilot burner is not in danger of being put out by the vitiation of smoke-box vacuum or the excessive pulsation of draught.

The cooling water pipes from the engine jacket and heads provide a circulating path for the water, and assist the steaming properties of the boiler. For the circulation of the water between the cylinder jackets and the boiler, the thermo-syphon is relied upon during running periods, but for the primary steam raising, circulation is induced by special steam pipes. The calculated steaming capacity of the evaporating surface is 8000 lb. per hour.

The boiler assemblage is supported entirely by the main crank case. This forms an engine entablature which houses main and jack shaft bearings and all the component parts of the power unit, rendering every working member of the machine independent of road stresses. Although for the first locomotive steel castings are employed, future engines will probably incorporate cast iron entablatures, as the symmetrical disposition of cylinders, bearings and details imparts to the castings a straightforward character that is free from incalculable stresses.

Though this entablature is enclosed, access is obtained to various parts by the easy removal of aluminium covers. Accessibility with an enclosed crank case type of engine must, it is true, be inferior to that of the usual direct-driven engine with open bearings, &c., but the forced lubrication and low bearing pressures are calculated to reduce the need of such. For examination detachable covers of aluminium—the heaviest weighing 23 lb.—are provided over all the important details. For repairs or renewals, it is possible to withdraw as a unit—after breaking the pipe joints, removing one small cover, cylinder drain cock, cylinder bolts, little-end caps and steam valve—the complete combustion head with valves in place, cylinder jacket, liner, gland, piston-rod, crosshead, steam chest, cylinder cover, rod packings and lubricator check valves.

For valve replacements the inlet valve being caged comes adrift complete with spring and rocking lever, leaving an aperture through which the exhaust valve may be removed or re-ground in position. It is not necessary to disturb the air silencer pipes, thus only six nuts need be removed. The connecting-rods may be removed without disturbing the crosshead or slide bars, and further to facilitate these operations or valve setting, a hand turning gear is provided on the engine crank shaft.

Restrictions of load gauge do not admit an eight-throw shaft for the eight cylinders. A four-throw shaft is therefore inserted, and in view of the necessary surfaces for bearings a combination of connecting-rod big-ends is introduced, such that one crank pin is common to a front and hind cylinder. In the present form the outside circular shell of one big-end provides a bearing for the forked end of the other. The surfaces have been made so large and the lubrication so generous that the wear is likely to be inconsiderable—when it occurs it is to be taken up not by fitting, but by re-metalling.

The friction-damped spring drive will be understood by reference to Fig. 9. It is composed of the gear rim A floating on two discs B B fixed to the jack shaft, and a series of spring elements C engaged with both gear rim and discs. The application is as follows:—There are projections on the gear rim and holes in the jackshaft discs, the latter *b* straddling those of the former *a*. Between them, making, as it were, a bridge connection, lie the spring elements C. These are composed of two bolsters *d d* which face one another. Their backs lie against the projections of the rim *a a* and the edges *b b* of the holes in the discs respectively. Their faces present anticlines to one another.

In the space thus formed between these opposing slopes there slide backward and forward two wedge pieces *f f*. These carry through their centres the springs *c c* which

provide resilience. Pressure from the back of one bolster is communicated to the face of the opposing bolster by means of the interstitial wedge pieces *ff*. The wedge pieces move down the slopes in communicating the load from the gear rim to the jack shaft discs, but are restrained in movement and restored in position by the springs. The springs are wound opposite hand; they are of different rate and resonance is destroyed by friction of the wedge pieces on the slopes. Adequate lubrication is provided where necessary, oil grooves being cut to take full advantage of the centrifugal effect imparted to the oil.

A cam shaft for front and back cylinders is driven through reducing bevels by a longitudinally placed central shaft, running at engine speed. This shaft is driven through further reducing bevels from the cross shaft, which is running at twice engine speed. This arrangement of drive presents little obstacle to the general accessibility of the engine.

Forced lubrication to all parts is supplied by a valveless rotary pump, gear driven from the jack shaft. The pump is a maker's speciality, it is automatic in reversing and it delivers through the same orifice for either direction of rotation. A gauge in the cab records the pressure in the system and a hand pump connection is provided for emergencies. Two pumps are provided, one for the gear sprayers exclusively and the other for bearings, connecting-rods, crossheads, steam valve gear and cam shafts. As the pumps are mounted directly on the engine sump, any leak from the glands drains back into the sump.

In the cylinder unit the various cast iron portions are relieved of undesirable stress. The combustion head has a cast steel shroud shrunk on, which relieves the bursting load due to boiler pressure inside, and also transmits all the combustion load to the cast steel cylinder jacket, thus relieving the cast iron head of tensional stress. The liner is free to expand through the packed gland at the steam end of the jacket, and is stressed only by the internal pressure of combustion and the exterior pressure of the steam water of the jacket, the latter counteracting the more severe effects of the former. This jacket transfers the load to the entablature, the longitudinal walls of which are straight and unpierced and connect the cylinder flanges direct to the crank shaft bearings. The ensemble results in a sturdy construction.

Full advantage has been taken of the loading gauge width for the cab and footplate; seats are provided for the operator and his assistant. The controls are so placed that the driver need not leave his seat to perform any of the manipulations required, and the fireman, having no arduous task in maintaining steam, can assist in any duties demanded by routine. Due to the absence of coal dust and firing tools, a neat, clean, well-lighted compartment for the crew is provided.

The controls consist of a steam regulator, oil regulator, reversing gear and the usual brake valves. Handles for automatic brakes, cylinder cocks, sanding gear and air duct dampers are conveniently arranged. Injectors and hand brake will be under the care of the assistant.

The small diameter of the boiler enables large windows to be provided in the cab front, whilst the disposition of the tanks permits a generous look-out for running in reverse.

Under normal conditions of load and grade the process of starting the engine is as follows:—Having put the steam gear over to full gear position—which ensures the combustion gear being set correctly—and having opened the oil regulator to "start" position, the steam regulator is opened and the engine moves away. Within a few revolutions of the driving wheels the oil side fires at a low power, the first combustions being almost imperceptible because in the "start" position the spill valve returns most of the oil to the tank. As the speed increases the steam gear is notched up, and the oil regulator is advanced to running position. At any speed above about 6 miles per hour, the steam regulator may be closed entirely and the oil engine relied upon.

To stop, the oil regulator is moved round to the "off" position, and if steam is being used its regulator is closed and the brakes applied in the usual way. In case of emergency stops, the steam gear could be reversed and the steam regulator opened. In the case of special need for acceleration, steam will be used to judgment according to the circumstances.

The traction curves in Fig. 10 are worked on Professor Dalby's system. Comparisons are made in the upper right-hand diagrams between three engines—a Kitson-Still, an engine with 20in. by 26in. cylinders and 5ft. 8in. wheels, and another engine with 18in. by 24in. cylinders and 4ft. 10in. wheels, all drawing similar loads. In the lower right-hand diagram a comparison is made of the same engines on the basis of the length of time it takes each of the engines to arrive at a specified speed; on the left-hand side are to be noted the distances which each of the engines will have travelled by the time they reach a specified speed.

It will be noted that while the 20in. by 26in. engine has the advantage in traction at one short period—see upper right-hand curve—the internal combustion locomotive is in advance all the time—see lower right-hand curve.

The Kitson-Still has provision for treating unusual occasions when it is required to start a heavy load on bad grades. Means are provided by which it is possible to relieve the compression on the combustion side during the first few revolutions. This can be done by bringing the combustion valve gear into "mid" position, where all valves are lifted from their seats and the fuel pump plunger is held off its cam. When the effective force of the steam is not reduced by the act of compressing air in the internal combustion end, the torque variation is similar in character to that of an ordinary steam locomotive, with this important difference, that the episodes of high and low torque occur in the Kitson-Still approximately eight times in one wheel revolution as opposed to four times in the former—an advantage that is greater than is implied by the mere fact that it is about twice the frequency.

For starting, brakes and train heating, steam is the source of energy. By its essential flexibility it replaces for starting and low-speed work a clutch and gear-box, electric or fluid transmission, and enables a unit complete in itself to accomplish the extraordinary requirements demanded by rail traction. It enables also a staff trained for the maintenance of any ordinary reciprocating engines to adjust or repair or inspect the entire mechanism of the locomotive with very little special training. The controls and operations will be familiar to the driver of steam locomotives and the general appearance reminiscent of his usual charge.

Shunting, backing on to a train or moving about the

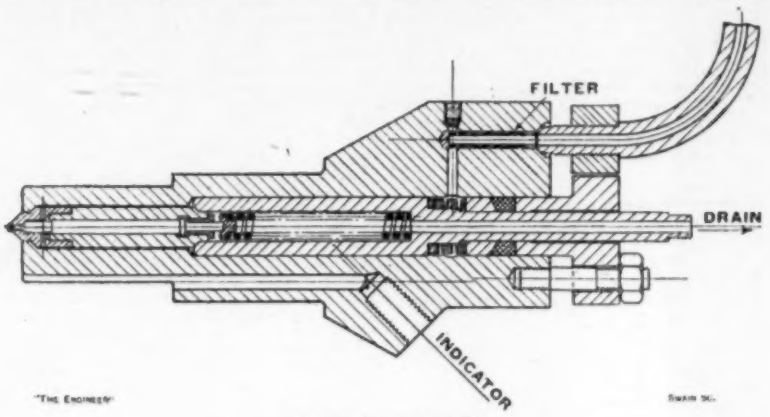


FIG. 6—FUEL-JET ASSEMBLY

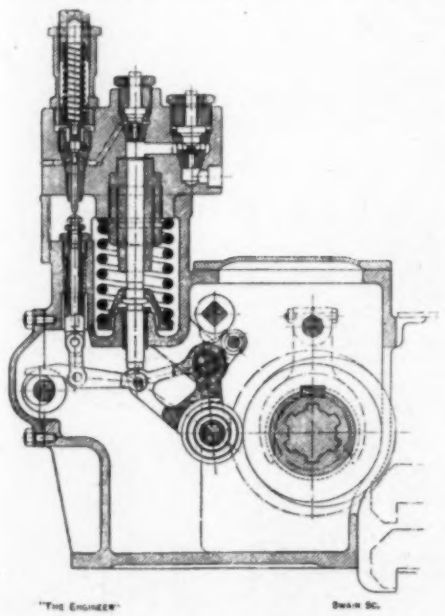


FIG. 7—FUEL PUMP

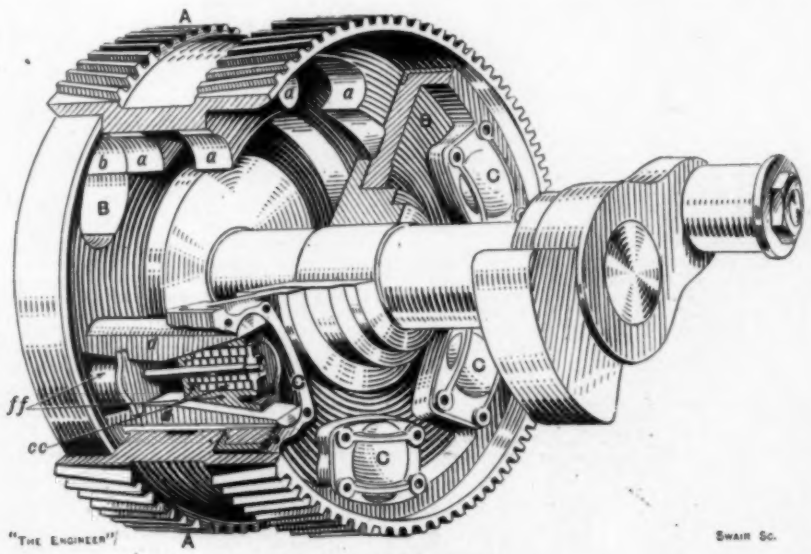


FIG. 9—SPRING DRIVE

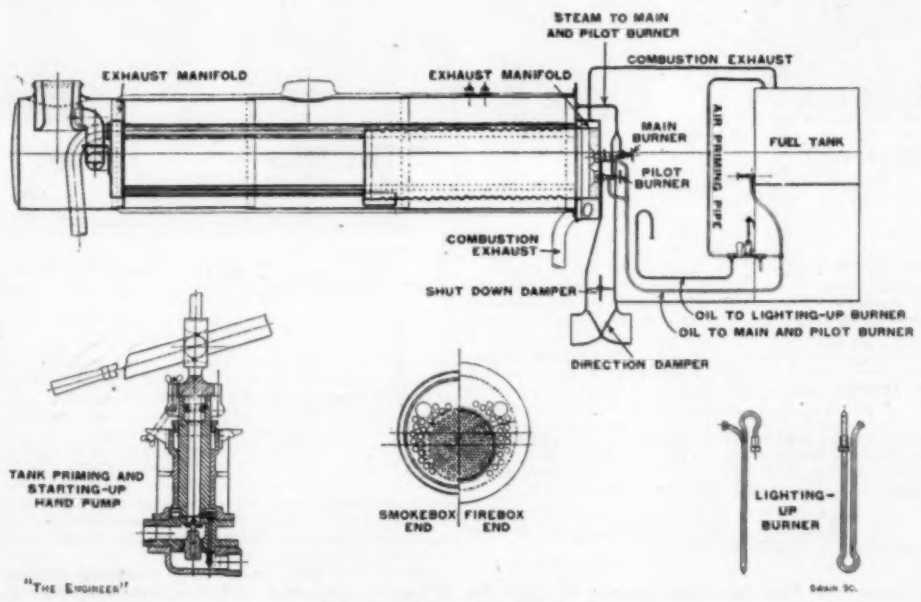


FIG. 8—BOILER AND FIRE-BOX

yard and sheds can be done on steam alone by the controls familiar to all.

Two of the greatest difficulties to be faced owing to the necessity of adding to an internal combustion power unit the machinery of a variable transmission are the distribution of the weight on the axles and the maintenance of a reasonable weight per horse-power. To meet the first the concentrated engine entablature can be placed in such relation to the driving axles as to bring about a satisfactory distribution. To deal with the second, the use of steam partially created by the waste heat of the engine provides one of the lowest weights per horse-power of the many attempts at the problem.

It was the expressed opinion of Mr. Vauclain whilst addressing the Mid West Power Conference at Chicago in January, 1926, that the first consideration in applying a heavy oil engine to the locomotive was the weight per horse-power developed. In the Diesel electric locomotive 275 lb. per horse-power was the figure then obtained, "but a 20 per cent. reduction was hoped for."

Whilst not being able to state what the weight per horse-power of the later Diesel mechanical transmission locomotives is, it is interesting to compare this figure of 275 lb. with the 184 lb. per horse-power obtained on the Kitson-Still proposal under normal power, and this under overload conditions is reduced to 120 lb.

Capital.—The last point to be treated, as it will be the first question to be asked, is the cost.

It is submitted that though the cost of such new details as are involved in an internal combustion power unit is out of comparison with the simple mechanism of a steam locomotive, still there is the advantage of a four-fold repetition in this design and of small and readily jigged parts.

The expensive modern boiler is reduced to a comparatively simple regenerator, and the erection or maintenance of this particular locomotive may be carried out with the most meagre shop equipment. A 6-ton crane would lift the heaviest detail assuming that the complete structure is put upon its wheels by the simple and very usual process of jack lifting.

It does not appear unfair therefore to set the initial cost on a parity with a steam unit of the same power, and as to maintenance and simplicity for repair, it is hoped that this preliminary description will have proved adequately reassuring.

Fuel Consumption.—The tests point to a consumption of 0·37 lb. as a maximum per indicated horse-power for running conditions. This calculation receives interesting confirmation from the history of the m.s. Dolius. In the case of that ship, equipped with Scott-Still engines—displacement 11,533 tons—the Marine Oil Engine Trials Committee recorded a consumption of 0·32 lb. per indicated horse-power at full normal power for engine alone, while during and after actual service of voyages totalling 144,000 miles this figure has been and is being maintained.

It is, of course, impossible to achieve under locomotive conditions such a record. The short period of full load, the absence of condensers and the necessity of a wide range of flexibility, limit the economy attainable. But it is safe to assume that an overall figure, including oil burnt whilst firing the boiler for starts, will not exceed 0·4 lb. per indicated horse-power hour, and Fig. 11 appended shows the relative cost per annum of oil and coal as fuel, assuming 35,000 miles per annum, 60 lb. of coal per steam locomotive mile, 8 lb. of oil per internal combustion locomotive mile for comparative engines—for example, the Kitson-Still locomotive, burning fuel at 80s. per ton, would cost roughly £500 per annum. For a comparative steam locomotive, using coal at 21s. 6d. per ton, the fuel bill would be approximately £1000 per annum. The difference will be very marked in certain parts of the world—for instance, a waterless district is known where coal costs 50s. per ton and water is a great expense to obtain and to haul. The saving on fuel is £1842 per annum there if oil is obtainable at 80s. per ton.

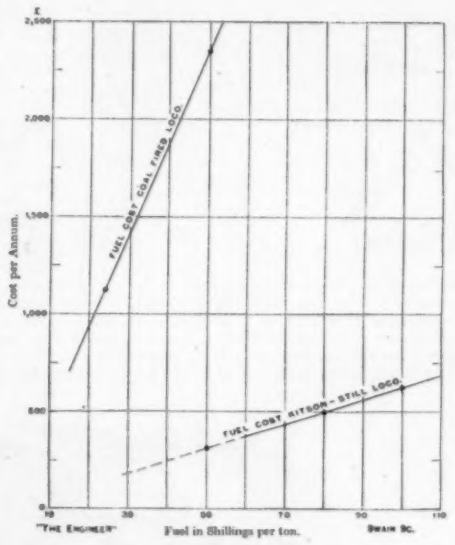


FIG. 11—COST DIAGRAM

Water Consumption.—The consumption of water in this engine is one-tenth that of a steam locomotive of similar power in equivalent service, and if in certain countries water difficulties are excessive, it would be possible to effect a still further saving with a very reasonable size of condenser, as the total use of steam is so inconsiderable.

In a review of the various points in the design of this engine, probably the most important is the symmetrical disposition of details about the central shaft and gears. By this means accessibility is made very real, the main driving gears operate under the best conditions, a simple and stiff crank shaft is possible, latitude for wheel position is obtained, and cam shaft and pump operations are effectively synchronised.

With the enclosed forced lubricated type of engine there is brought into the locomotive sphere the reliability and lack of maintenance charges which obtain in marine and stationary fields. The motive unit is so disposed as to form an inflexible mass in the centre of construction incorporating two pairs of rail wheels. The remaining coupled wheels, if subjected to lateral movement, are as free as in any locomotive, whether of plate or bar frames. The entablature is inflexible in itself, but it is borne upon wheels with a certain slack between tire and rail springs. It is therefore susceptible to lateral vibration, and inside it there are, it is recognised, forces involving problems of balance, to which it is subject.

The disposition of cylinders and cranks, whilst providing inherent primary balance of reciprocating and revolving masses, leaves the designer faced with a transverse secondary couple unbalanced. Due to the comparatively high engine speed, this couple, whilst it would not conceivably impair the road-worthiness of the locomotive, may cause vibration of high frequency. Therefore balance weights have been added to the crank shaft, which reduce the value of this couple to a figure well within accepted and successful practice, and yet do not produce forces in a vertical plane of a magnitude sufficient to disturb the spring-borne mass.

Such is the engine which in a few months will be submitted to the chances and changes of the open road. Whatever its adventures may be, it is hoped that it will prove a servant in the traffics of main lines and add a useful item to the export schedule of this country.

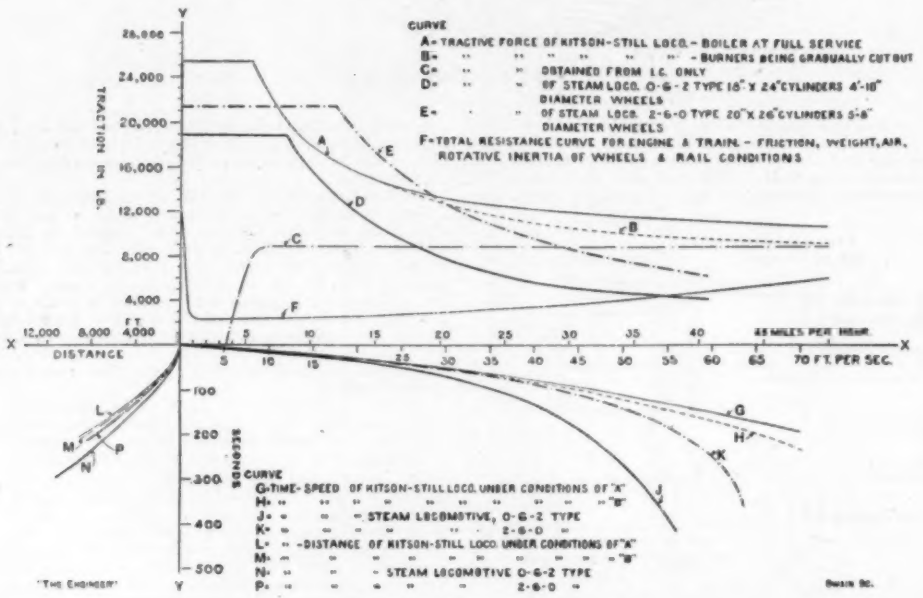

CURVE
A= TRACTIVE FORCE OF KITSON-STILL LOCO.- BOILER AT FULL SERVICE
B= " " " " " " - BURNERS BEING GRADUALLY CUT OUT
C= " " OBTAINED FROM I.C. ONLY
D= " " OF STEAM LOCO. O-6-2 TYPE 18" X 24" CYLINDERS 4'-10" DIAMETER WHEELS
E= " " OF STEAM LOCO. 2-6-0 TYPE 20" X 26" CYLINDERS 5'-8" DIAMETER WHEELS
F=TOTAL RESISTANCE CURVE FOR ENGINE & TRAIN - FRICTION, WEIGHT, AIR, ROTATIVE INERTIA OF WHEELS & RAIL CONDITIONS
TRACTION IN LBS.
28,000
24,000
20,000
16,000
12,000
8,000
4,000
FT.
12,000 8,000 4,000
DISTANCE
5 10 15 20 25 30 35 40
45 MILES PER HOUR
5 10 15 20 25 30 35 40 45 50 55 60 65 70 FT. PER SEC.
SECONDS
100
200
300
400
500
CURVE
G=TIME-SPEED OF KITSON-STILL LOCO. UNDER CONDITIONS OF "A"
H= " " " " " " " " " " "B"
J= " " - STEAM LOCOMOTIVE, O-6-2 TYPE
K= " " " " " 2-6-0 "
L= " -DISTANCE OF KITSON-STILL LOCO UNDER CONDITIONS OF "A"
M= " " " " " " " " " "B"
N= " " - STEAM LOCOMOTIVE O-6-2 TYPE
P= " " " " 2-6-0 "
"The Engineer"
Swain Sc.

FIG. 10—TRACTION CURVES

During the July-September quarter of 1926 the assistant inspecting officers of the Ministry of Transport held thirty-nine inquiries into the more serious accidents to railway servants, of which fourteen were fatal cases, and as in one instance five men were killed, the total killed was eighteen. In seven instances the deceased men were guilty of want of care, in three other servants were at fault, in one the responsibility was shared, and in three the cause was misadventure. The five men mentioned above were pointers who were run down in a fog.

Conference on Engineering Materials.

A Conference on Engineering Materials is to be held in Berlin from October 22nd till November 6th next. The Conference will be held under the auspices of the Verein deutscher Ingenieure; the Verein deutscher Eisenhüttenleute; the Deutsche Gesellschaft für Metallkunde; the Zentralverband der deutschen Metall-Walzwerks- und Hütten-Industrie; the Zentralverband der deutschen elektrotechnischen Industrie; the Deutscher Verband für die Materialprüfungen der Technik; the Deutscher Normenausschuss; several notable consumers' associations; and the Messeamt der Stadt Berlin. Concurrently with the Conference there is to be an Exhibition of Engineering Materials which will remain open till November 13th. As far as can be seen at present, about 300 papers will be read at the conference, some of which will be on the following subjects:—Heat-resisting Alloys; New Problems concerning Materials for Steam Turbine Construction; The Value of Tests on Small-scale Models for Testing Materials for Aircraft Construction; the Wearing Strength of Wheel Tires and Rails in Railway Service; Requirements of Boiler Materials; Rust-proofing by Surface Treatment; Acid-proof Alloys; Tools and Machine Tools for Machining Light Metals; Copper and its Alloys; Aluminium and its Alloys; Soldering Aluminium; Forming and the Properties of Materials; the Hardening of Steel; Refinable Aluminium Alloys; Aluminium Alloys for Castings; Methods of Testing Bearing Metals; Internal Stresses and their Removal; Nickel and its Alloys; Melting and Casting of Metals; Die-pressing; Softening Heat and Re-crystallisation; the Best Hardening Processes for Various Steels by which the Longest Life of the Cutting Edge can be Obtained; Non-ferrous Sheet Metal for Springs; Corrosion of Aluminium and its Alloys; Behaviour of Porcelain as an Insulator when Exposed to Simultaneous Electrical and Mechanical Strain; the Metallic Engineering Materials in the Chemical Industry; Non-corrosive Steels; the Uses of Drawn Material, &c.

Further particulars may be obtained by application to Werkstofftagung, Ingenieurhaus, Friedrich-Ebertstr. 27, Berlin, N.W. 7.

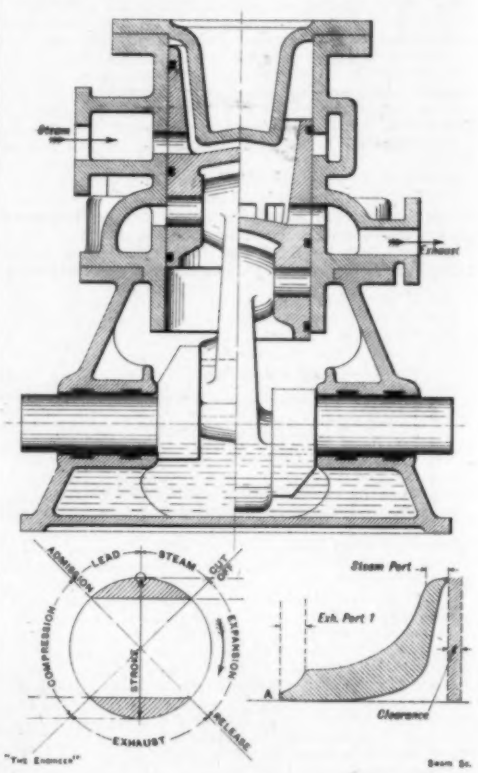
Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

A SMALL AUTOMATIC STEAM ENGINE.

Sir,—I notice on page 392 of your issue of the 8th instant a description of a small automatic steam engine with a novel and very simple valve gear, and it has occurred to me that perhaps it would interest your readers to know that small engines, with even simpler valve gear than the one illustrated, were made in this country somewhere about 1902.

I enclose a rough hand sketch showing in section the engine I refer to, which was one of my early inventions, and was made by W. Reavell and Co., Ltd., of Ipswich. One half of the section shows the piston at the bottom of its stroke, and the other half at the top of its stroke.

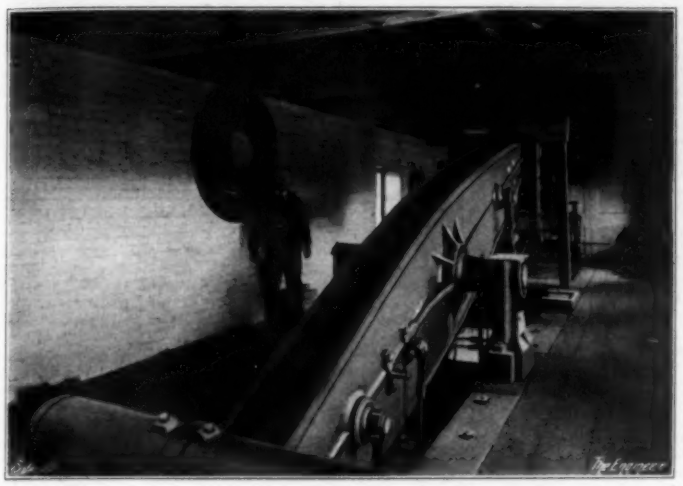


You will see there is no valve gear whatever, the arrangement of the ports in the piston and in the cylinder answering the purpose of a separate valve gear.

These little engines were made up to about 5 horse-power and to run as high as 3000 r.p.m. perfectly silently owing to constant thrust, and, as is obvious from the diagram, with good economy.

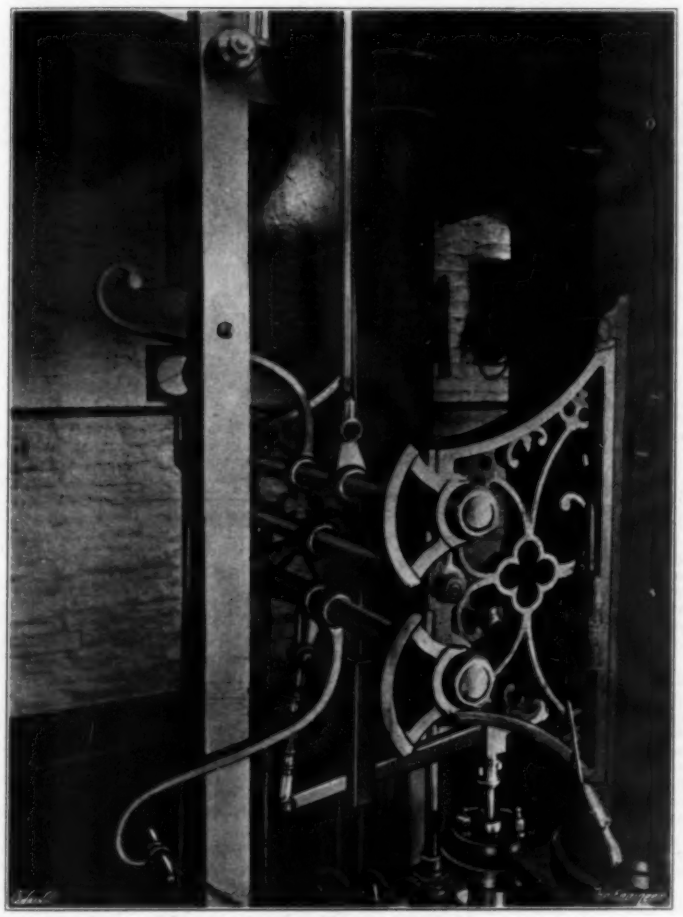
They had the characteristics of a two-cycle motor car engine, particularly as they were liable to start and run in either direction. I think the sketch I am sending you, showing also a typical indicator diagram and the steam distribution, will make quite clear to you how this engine worked. It necessitated

OLD BEAM ENGINE AT THE TRING FORD PUMPING STATION



GENERAL VIEW OF BEAM

CYLINDER HEAD, PISTON ROD AND VALVE GEAR



HAND STARTING GEAR

END OF BEAM WITH CROSSHEAD AT TOP OF PISTON ROD

a rather deep piston, but as the engine had no crosshead guides and was single-acting, this was not a disadvantage.

These engines were originally intended for little electric lighting sets on board steam trawlers, a common interchangeable unit being used throughout the fleet.

Lincoln, April 13th. EDWIN W. JONES, M.I. Mech. E.

AN OLD BEAM ENGINE.

SIR,—With reference to the letter from Mr. W. J. Barker in your issue of April 1st, describing an old beam engine, I thought perhaps the enclosed photographs of another old engine which is now being dismantled might be of interest.

This beam engine was erected for the Grand Junction Canal at its Tring Ford Pumping Station in 1803 by a Mr. Jonathan Woodhouse, of Ashby-de-la-Zouch, the estimate being for erecting an engine to lift 1,659,960 gallons of water in twenty-four hours 75ft. high. Although there are several references to the contract in the General Committee minutes of the company for the years 1802–3, there is unfortunately no mention of the cost of the work.

The engine appears to have been originally a Watt engine, subsequently modified to the Cornish type as higher duty and greater economy were demanded of it. It may thus be said to present an interesting epitome of the changes which took place in the nineteenth century in pumping engine practice.

In 1836 a new well was sunk and a new heading driven to Wilstone Reservoir, the engine being turned round so as to pump from this new well, and a second beam engine known as the "York" engine was installed to take on the "old" engine's original duty. This latter engine was superseded by a Diesel-electric plant some years ago.

During the 'fifties the cylinder was bored out and a new piston and cover fitted, and in 1892 a new clack valve was fitted to the pump, but as far as I am aware these are the only important replacements that have been made.

The engine has worked on in its present position from 1836 until a few weeks ago, and it regularly lifted 134,400 gallons of water per hour to a height of 75ft. 9in., working at about thirteen strokes per minute under a boiler pressure of 24 lb. per square inch. The cylinder diameter was 48½in., the stroke 8ft., and the length of the beam was 24ft. During the last ten years the engine has worked on an average 1030 hours per annum, the average cost of the actual pumping being 3s. 6d. per lock of 56,000 gallons, but after adding for boiler cleaning, repairs, standing by, &c., this figure is increased to a total of 4s. 6d. per lock. This compared most unfavourably with the other plant, and as a result it is now being replaced by a set of vertical-spindle electric pumps, but apart from the cost of working, the "old" engine could always be depended upon to raise its customary quota of water and the level of the reservoir made very little difference to the quantity of water lifted. W. YATES,

Engineer, Grand Junction Canal.

London, April 11th.

COAL ASH AND PROBABILITY.

SIR,—By chance I have only just read the interesting article on "Coal Ash and Probability" in the issue of THE ENGINEER for January 14th last, and I beg to add the following remarks.

It is quite understood that the probability of an accordance between the ash content of the sample and the actual ash content of the consignment or the wagon will become the less the smaller the weight of a sample and the lower the number of samples is. In practice one tends to get a more accurate accordance by increasing both factors.

As a basis for a single sample a relatively large quantity of coal is used, which is rendered as homogeneous as possible by grinding and mixing and from which the laboratory samples are taken, so that by continuous dividing the laws of chance are strictly observed. In actual operation one takes the samples from various wagons of a train in order to get a value, resulting from a great many samples, although it may only be an average value.

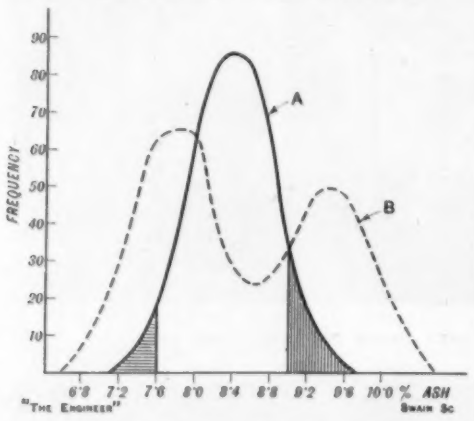
A simple variation of sampling seems to be possible, if we consider that an average value is practically without any importance, as for the control of actual combustion a uniform coal with perhaps a slightly higher ash content is rather preferred to another coal, when one-half of the required quantity has an ash content of 20 per cent. and the other half only 5 per cent.—which will also correspond to an average value of 12·5 per cent.

For research work in actual operation and for determining the qualities of material a new method, the so-called "Gross-Zahl-Forschung"—a term which may best be translated as "large number research"—has been applied for some years past in Germany. This method involves the application of the statistical law of large numbers to practical research work.

As the practical engineer prefers a plain graphic process to a complicated calculation, he likes to make use of frequency curves. As compared with the average value, the frequency curve not only gives a value which accounts better for chances and mistakes, but it also indicates the dispersion of the results, which is so important for actual operation.

Applied to the present case, the sampling of coal, the procedure is to take samples for analysis daily from every train of coal and to record the results by means of a graph, the abscissa

representing the percentage of ash, moisture, sulphur, &c., whilst the ordinates show the frequency—that is to say, how often the various percentages occur. After a month an ash content curve of the form shown at A in the accompanying diagram is obtained. In the case exemplified out of a total of 247 analyses 209 fall between the range of 8·0 to 8·8 per cent. ash, 21 between 7·2 to 7·6 per cent., and 17 between 9·2 to 9·8 per cent. ash. The normal value for the ash content of the coals supplied at the time of sampling lies according to the peak of the curve near 8·4 per cent., and this value may be taken as the base for the valuation. If any special penalties were exacted or premiums paid for ash contents above 9·0 per cent. or under 7·6 per cent. respectively, the cross-hatched areas of the figure, compared with the total area, would show the



amount to be debited or credited. Furthermore, a comparison of curve A and the dotted curve B, in spite of corresponding average values, shows that coal A is much more uniform and more suitable for consumption than coal B.

A continuous record and comparison of the frequency curves helps to recognise uniformity of material supplied, and this uniformity of supply is much more important for boiler operation than low ash or moisture content of single wagons of coal.

It is evident that similar frequency curves may be successfully applied also to steel analysis, allowances of size, weights, waste and rejections of single machines or whole plants, and even to the variations of the rates of exchange.

DR.-ING. K. DAEVES, M. Inst. Met.

Düsseldorf, April 14th.

SIXTY YEARS AGO.

WE have on previous occasions in this paragraph noted the unsatisfactory nature of many of the measured mile trials made with the steamships of sixty years ago. These trials were commonly regarded as affording a fair opportunity for getting more out of a vessel than she could be expected to accomplish in regular service. "Jockeying" was resorted to to such an extent that many people were in favour of abolishing measured mile trials completely and replacing them by prolonged trials at sea. In a paper entitled "On Trials of Steamships at the Measured Mile," which Mr. E. J.—later Sir Edward—Reed read before the Institution of Naval Architects, and which we reprinted in our issue of April 19th, 1867, some particulars are to be found of the practices adopted on measured mile trials. When the vessel was off the mile the steam would be "bottled up" to be let into the cylinders at full rush when she got on to the mile. The vessel would be run in the full strength of the tide when going with it, and in the slack water near the shore when going against it. The average speed would be deduced from an odd number of runs, the odd run being made with the tide. The wrong object would be brought on to the mark indicating the beginning or end of the mile. In one instance quoted by Mr. Reed one end of the mile was marked by two posts and the other by a post and the side of a house. By bringing the post on to the wrong side of the house the vessel's true speed of 10½ knots was made to appear as 11 knots. On another occasion, according to Mr. Reed, a steamer was credited with a very high speed as a result of selecting three out of several runs over the mile—two with the tide and one against it, and even that one was made by some means to show a much higher speed than the other runs in the same direction. Mr. Reed made it clear that no jockeying was permissible or possible in the measured mile trials of her Majesty's ships. These trials were carried out under the control of naval officers, who were in no way responsible for the success or failure of the vessels, and were "usually attended by gentlemen of the Press, whose observation of the proceedings was very close." In spite of the opportunities for falsification of the results, Mr. Reed firmly believed in the value of measured mile trials. He regarded them as occasions more of scientific than of commercial interest. Prolonged trials at sea were, he maintained, not trials of the engines and boilers and the speed of the ship, but first and foremost trials of the endurance of the engineers and stokers. Measured mile trials provided the means of obtaining performance figures for a ship which could be compared with the figures obtained from other vessels under similar conditions. There was no assurance, he argued, that the data obtained during sea trials away from the measured mile were comparable from ship to ship.

A TOTAL of 31,000 million cubic feet of earth and rock, enough to have reduced the surface over the entire 22 square mile area of Manhattan Island by 50ft., has, it is said, been cut, blasted and drilled from the island since excavation first began for buildings, subways and public service conduits. Excavation operations will entail this year an expenditure of 150,000,000 dollars, or more than six million times as much as Peter Minuet paid for the whole island 300 years ago.

Railway Projects in Africa.

SEVERAL most important railway schemes, which will, in a few years, effect a complete revolution in existing transportation routes are either in course of being carried out or are to be proceeded with at a very near date.

Bridge Over the Limpopo River.—It was announced in February that an agreement had been reached between the Rhodesian and Union Ministers regarding the construction of a bridge over the Limpopo River near Messina, and the linking up of the present S.A.R. railhead at Messina with the Rhodesian system *vid* such a bridge. At present Rhodesia has to depend almost entirely on the port of Beira for outlet to the sea, and the single line of railway concerned has to bear a constantly growing stream of traffic both ways by which in normal times it is severely taxed. In addition, the route is subjected to serious washaways and prolonged hold-ups every wet season, which make the position almost insupportable. The chief object to be secured by Rhodesia is therefore an additional outlet to the sea, and the aim of opening up extensive areas of new country in Southern Rhodesia seems to be entirely subordinate to access to a new port. If Messina and West Nicholson were connected, up there would be a direct route between Delagoa Bay and the various rich mineral deposits of Northern Rhodesia. The actual saving of mileage would not be very great so far as Northern Rhodesia is concerned. The distance from Buluwayo, taken as a focal point, to Beira is 673 miles, and allowing 90 route-miles for the Messina–West Nicholson line, the distance to Delagoa Bay is 640 miles. The more important point is that the Beira line will be saved from being overwhelmed by Northern Rhodesian traffic and will be better able to attend to the transportation needs of Southern Rhodesia. As to the Union, additional traffic to Delagoa Bay will greatly improve the returns from the Selati line, and a certain amount of traffic may be sent *vid* Durban as well. It must be added, though, that the Rhodesian Government has not yet fixed upon the final site on the Rhodesian side of the Limpopo for the new railway station, which will constitute the railhead of the Messina extension, but the Prime Minister of Rhodesia states that at present it will only be a few miles into Southern Rhodesian territory, and that there is no intention of linking up the Messina line with West Nicholson or Fort Victoria under the present scheme. The proposed new bridge will be constructed at a site some 500 yards below Leibig's Drift on the Limpopo. The site chosen presents no particular physical or engineering difficulties. It is estimated that the bridge will be 1500ft. long.

Railways in the Congo.—An unbroken journey in the same railway compartment from Cape Town to Rhodesia and on to Matadi, almost on the border of the Belgian Congo, and within a comparatively short distance of the West Coast of Africa—a total of just under 3800 railway miles—will be possible within the course of the next three or four years according to Mr. George Bousin, general manager of the Congo Railways, who has been at Johannesburg recently. Railway construction in the Belgian Congo is proceeding with intense activity, he stated, and because of the fact that his own railway company had decided to embark on an ambitious project, at a cost of £2,000,000, to widen the gauge of the present railway from 2ft. 6in. to 3ft. 6in., and because the Belgian Government had decided to construct lines all of 3ft. 6in. gauge, it would be possible for a traveller to pass from Cape Town to Matadi without moving from the carriage into which he entered at Cape Town. On the Belgian Government lines a distance of 2500 miles from Kanima to Ilibo on Kassai River yet remains to be completed. When that construction is finished it has been decided that the railway line between Leopoldville and Ilibo, 400 miles apart, will be linked together in a railway chain at a cost of £3,000,000. Then it will be possible to travel through an immense portion of Africa comparatively unknown at present. The decision had, he added, already been come to by his company, the Compagnie Africaine de Construction, to spend £2,000,000 on widening the gauge of the railway between Matadi and Leopoldville, some 300 miles apart, and the Belgian Government had sanctioned the expenditure of £3,000,000 on the construction of a line between Leopoldville and Ilibo, provided alterations on the first-named line were carried out. Completing the line between Matadi and Leopoldville will take three years, and by that time the line between Ilibo and Kanima should be finished. A start should also have been made on the Ilibo-Leopoldville line by then.

The Lobito-Katanga Railway.—A third railway enterprise, the construction of the Lobito-Katanga Railway, is being pushed on steadily to the Congo border. It will serve Angola, the Congo and even Northern Rhodesia. It is anticipated that some of the traffic which at present finds its way from the latter district over the Rhodesian and Union systems will be diverted along the Benguella Railway—known also as the Lobito-Katanga line. The specific object of the line is to furnish an outlet to the Atlantic for the rich Central African regions in the Upper Congo basin. When completed, mail steamers will, it is expected, take passengers to London from Lobito Bay in fourteen days. The engineering aspects were difficult, thirty-eight bridges being involved in laying the first 100 miles of line. When completed the Katanga mineral belt will be brought into much closer touch with Europe. Taking the time of passage from London to Cape Town at the standard of seventeen days, another seven to eight days must be added for the railway journey to the Congo, making from twenty-four to twenty-five days' actual travelling between London and the Katanga copper belt. It is expected that the new line will effect a saving of eight days. In preparation for the anticipated traffic work is being strenuously carried out at the port to provide accommodation for large steamers, and slowly but steadily Lobito Bay is becoming an imposing port of entry.

The Shire, Central Africa and Trans-Zambesi Railway.—The fourth scheme, which involves the Shire, Central Africa and Trans-Zambesi Railway, the deep-water wharf scheme at Beira and the Tete coalfield, is the one about which probably most is known in Britain, because of the fact that the British Government is—or was—going to guarantee the £10,000,000 which would be required. The Joint East Africa Board, in January, 1926, in a memorandum to the Colonial Office (British) in favour of the proposed bridge over the Zambesi at Sena, submitted a scheme to the Colonial Office and the Treasury—in conformity with the recommendation of the East African Commission—for the merging of the Shire Highlands and the Central African Railways and the Government acquiring an interest in the combination. The scheme also suggested a method of raising funds to build the Zambesi bridge as well as an extension of the Shire Highlands Railway to the western border of Nyasaland in the direction of the Tete coalfields. It is to be regretted that the far-reaching importance of this scheme to British influence and trade has not been more fully recognised by the British Colonial Office than it has. If it were fully understood there is no doubt that its carrying out would not only receive all necessary support, but it would be pushed on with as an urgent matter. A few points may be brought out in the following:—

The Zambesi Bridge.—The bridge across the Zambesi is the last link to be forged in the line which connects Nyasaland with Beira which is that country's only outlet to the sea. At present all goods from Blantyre have to be ferried across the river, which is 2 miles wide at low water, and that naturally increases the expense of handling. The transhipping in fact means that only valuable goods can be profitably exported, and while the river remains a barrier to the railway such goods as coal, base minerals or agricultural produce could never be handled at rates which would prove payable to the producer or to the railway. When the bridge is built, however, a huge territory, which is wonderfully fertile, will be opened up, and the transport of such goods will present no difficulties. One of the most interesting developments arising out of the bridge is the plan for connecting the Tete coalfields, which are of huge extent, with Beira, so that, with the bunker trade and export, this traffic will provide important and valuable work for the railway, which may attain large dimensions. The deep-water wharf scheme for Beira will, of course, materially assist. The bridge itself will cost at least £800,000 and will be one of the most important in the Empire. The river at this point is 2 miles wide at low water and is subject to rises of 26ft. at flood times, which spreads the water over the adjoining country to a width of about 7 miles, and careful provision has to be made for these floods in the design of the bridge. The bridge itself is to be 2 miles long and one of the spans is to be of the lifting type to allow steamers to pass, for the bridge is to have a clearance of only 10ft. above the high flood level. The Tete coalfield, being on the north side of the river, has no outlet to the sea until the bridge is built.

Another development that is likely to take place soon is the extension of the railway from Blantyre to the foot of the lake at Fort Johnson. The line will then be in an interesting position, for it will tap the great inland sea, Lake Nyasa, and will be the outlet of the whole trade of an inland coast line which must be nearly 3000 miles in length. The produce of this territory, which in time should amount to a considerable output, owing to the marvellous fertility of the country, will find an outlet to the sea through the railway and over the big new bridge, while by rail and lake steamer some of the very remotest parts of the erstwhile dark continent will be easily reached from Beira.

THE INSTITUTION OF WATER ENGINEERS.

THE thirty-second summer general meeting of the Institution of Water Engineers will be held at Scarborough on Wednesday, Thursday and Friday, June 8th, 9th and 10th next. By permission of the Mayor and Corporation of Scarborough, the meetings will be held in the Council Chamber, Town Hall, Scarborough. The following programme has been arranged. On the Wednesday morning, at 10 o'clock, an official welcome on behalf of the Borough of Scarborough will be extended to the Institution by the Mayor of Scarborough—Alderman J. Bielby—and the chairman of the Water Committee—Councillor J. C. Maynard. The chair will then be taken by the retiring President, Mr. Lewis Holme Lewis, M. Inst. C.E., M.I. Mech. E. The programme of business will include the presentation of premiums awarded by the Council for papers presented during 1926; the installation of the President-Elect, Dr. Herbert Lapworth, M. Inst. C.E., of Westminster, and consulting water engineer to the Scarborough Corporation, and the reading of his presidential address; also the discussion on papers. In the afternoon motor coaches will leave the Prince of Wales Hotel at 2 p.m. and proceed to Springhill Reservoir, Irton Pumping Station and Cayton Bay Pumping Station, passing Osgodby Pumping Station on the way. The return journey will be made *vid* the South Cliff. The twenty-eighth annual dinner of the Institution will be held at the Prince of Wales Hotel, Scarborough, at 7 p.m. for 7.15 p.m.

On the Thursday morning, at 10 o'clock, the meeting will be resumed in the Council Chamber, Town Hall, for the continuation of the discussion on papers. No set programme has been arranged for the afternoon. In the evening at 7.45 p.m., at the invitation of the Mayor and Corporation of Scarborough, members and their friends will be entertained at the Floral Hall at 8 p.m. On Friday morning at 10 o'clock, motor coaches will leave the Prince of Wales Hotel and proceed to Whitby *vid* Brompton, Allerston, Pickering, and Goathland Moors. A return to Scarborough will be made in the afternoon *vid* Robin Hood's Bay, Scalby, Hackness, Forge Valley, and East Ayton.

The following is a list of the papers and communications to be presented to the meeting:—"The Scarborough Waterworks," by Herbert Richardson, with addenda on the new works by Dr. Herbert Lapworth, M. Inst. C.E.; "The Geology of the Scarborough District," by R. C. S. Walters, A.M. Inst. C.E.; "Cementation of Strata Below Reservoir Embankments," by A. A. Barnes, M. Inst. C.E.; and "Pre-Cementation of a Reservoir Trench," by J. R. Fox, M. Inst. C.E.

THERE is a proposal on foot for the construction of a power plant of 50,000-kilowatts capacity at Shoalhaven for the supply of electricity to Canberra, Australia.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

CONSUMERS of iron and steel in the Midlands continue their policy of waiting for lower prices, and the market accordingly remains dull. The gradual improvement in the trading situation will probably be stimulated in some small degree now that the Budget suspension is over and industrialists know just where they stand as regards Imperial taxation for the coming year. Fears that new burdens might be imposed on industry have been banished, but industrialists hereabouts think the bill bigger than it ought to be, and hold that the burdens on trade have been aggravated by neglect of opportunites of retrenchment where it was possible. The heavy trades of the Midlands and Staffordshire are fairly active in a spasmodic fashion, and business in iron and steel must develop ere long. It is very noticeable that as arrears of orders are overtaken and contracts worked off values have a tendency to decline. New business must be obtained to employ the plants, and the only way to secure it would appear to be by lowering prices. In all departments there has been some slight giving way on the part of manufacturers, and further price concessions are anticipated in the near future.

Raw Iron Prices Wavering.

The firm stand made by the foundrymen and forgemen against high pig iron prices is, despite the fact that furnacemen have been unsuccessful in getting any material reduction in coke prices—the 22s. basis at ovens still prevailing—at last having effect. Last week there was some wavering on the part of Northamptonshire smelters, and this week Derbyshire makers, who last week were adamant, have shaded prices to accelerate and facilitate business. Derbyshire foundry is still quoted £4 2s. 6d., but a shilling or more has been taken off under pressure. Similar modification has been made in Northamptonshire foundry. There is little business passing in forge qualities. Northamptonshire has changed hands at £3 10s., but this price would not be accepted by many of the furnaces. Business continues on small tonnage lines, consumers being satisfied that better terms may be expected in the near future. Considerable interest has been exhibited in the trade returns, which show that imports of forge and foundry iron last month totalled 25,886 tons, as compared with only 9282 tons a year ago, although last month's total was slightly less than that of February. On the other hand, exports totalled only 11,863 tons, as compared with 46,059 tons in March last year and 4865 tons a month ago.

Steel.

There has been no further move in steel prices since I last wrote, but freer conditions exist at many of the mills, and the difficulty of securing immediate supplies is gradually disappearing. Producers, however, still demand a premium of half-a-crown to 5s. per ton on general quotations for early deliveries. There is a brisk inquiry for structural steel, but even in that department mills are rapidly overtaking engagements. At some of the big plants affiliated with the engineering branches there is still a considerable accumulation of arrears to be got through. Midland constructional engineers are only getting small orders, and they consider that a good deal of work is being held back owing to the high prices prevailing. Local rolling stock makers are busy, and have a good deal of work to execute against old orders, which were held up last year owing to shortage of raw material. Local makers of high-class steel continue to suffer from the dumping of heavy lots of foreign material during and since the coal stoppage. During the enforced idleness the Continent sold a good deal of high-class cold rolled material to local industries, such as the motor and cycle trade. The contracts were arranged at prices considerably below local quotations, and as this steel has not yet been disposed of the local makers continue to suffer. Continental semi-finished material is coming in at prices round about £5 7s. 6d. to £5 8s. 6d. per ton, slightly higher than before the coal stoppage. The native quotation is unchanged at £7.

Staffordshire Bar Iron.

Staffordshire makers of bar iron find business exceedingly slack, and the efforts being made to find outlets for their production are shown by the gradual but persistent decline in values. Marked bars which do not suffer severely from competition and for which there remains a steady demand are maintained at £14 10s., but Crown and nut and bolt bars have declined a further half-crown to five shillings per ton. In the former case Lancashire producers are eagerly canvassing the South Staffs. market, and local makers to secure the business must outbid them. Quotations as a result vary considerably, according to the circumstances of the case. They range, however, from as low as £11 per ton. Common bars for the nut and bolt and fencing industries are now on offer at £10 5s., but most of the orders are going to Belgium, which is selling No. 3 bars at £6 5s. delivered into the Black Country. Wrought iron gas tube strip is in quiet demand, values ranging from £12 10s. to £12 15s.

Galvanised Sheet Values.

Midland galvanised sheet mills have been offering price concessions in an endeavour to stimulate buying, and to some extent it has had the desired effect. Makers who a week ago wanted £15 7s. 6d. for 24-gauge corrugateds have booked orders this week at £15 5s., while those who recently wanted £15 5s. have accepted business at from £15 to £15 2s. 6d. per ton. At these figures a moderate tonnage of orders has come in both from home and foreign sources, the West Indies being the most productive of the overseas markets. New business is being eagerly sought.

Trade Expansion.

Midland industrialists point to the statistics of exports and imports during the month of March as showing the difficulty of trading under present high production costs. Existing costs form a heavy handicap to the iron and steel trades of this district, and it is disturbing to realise that during March we imported 478,109 tons of iron and steel, valued at £3,687,735, compared with 258,526 tons and £2,172,556 in the corresponding month of last year. For the year to date the quantity imported has been 1,476,986 tons, valued at £11,383,806, compared with 708,727 tons and £5,831,510—roughly double—in the preceding year. Deliveries against old contracts placed abroad during the coal strike are now nearing completion, and new business is placed very sparingly. On the other hand, exports of iron and steel and manufactures thereof realised £15,529,491 during the quarter just ended, against £18,255,561 in the first quarter of 1926. As the statistics prove that we are exporting more iron and steel as additional plant is brought into operation, it may be justly assumed that a better relation is now being re-established between imports and exports, and for that Midland manufacturers are thankful.

Increased Production.

As was anticipated, the statistics of production of iron and steel for the past month show that output continues to increase. Midland industrialists, however, scarcely expected to find as much improvement in the raw iron department as the figures reveal. A bigger output was recorded in March than for a very long time. That there should have been an additional 12 furnaces put into blast during the month, bringing the total to 178, is especially gratifying. At the end of April, 1926, there were in blast 147 furnaces, and at the end of March, 1926, 151. The output of pig iron in March, it is noted, amounted to 671,800 tons, compared with 571,100 tons in February and 568,500 tons in March, 1926. Of the total 229,800 tons were hematite, 221,400 tons basic, 167,700 tons foundry, and 21,200 tons forge pig iron. The improvement recorded last month in the steel department was maintained, the production of steel ingots and castings during the month being 949,600 tons, compared with 826,800 tons in February and 784,100 tons in March, 1926.

Midland Mining Developments.

Further important developments in the extension of Midland coalfields are foreshadowed. The latest reports emanate from the Cannock Chase area, where operations are being carried on by the Brereton Collieries, Ltd., preparatory to the sinking of two new shafts in the district lying between Hednesford and Wolseley Bridge. Extensive fields of coal are known to exist in the locality mentioned, and, prior to the war, borings were made on the estates of Sir Charles Wolseley, but the war caused the project to be suspended. It is understood that the plant which will be laid down will be of the most modern type and capable of dealing with a very big output, and that employment will be found for a large number of men.

Notts Miners and Trade Union Bill.

The miners in the Notts. coalfield, who are disgusted at the way the labour extremists have controlled the affairs of the Union, are said to welcome the Trade Union Bill, and large numbers of them hope the Government will be strong enough to carry it. The position in this coalfield is clearly demonstrated by the fact that out of 60,000 men at work in the Notts. pits only about 9000 belong to the Notts Miners' Association, 20,000 having joined the non-political Miners' Union, thus leaving 30,000 outside any Union.

Motor Engineering.

Many Midland motor engineering works are now working at full pressure, though others are finding business patchy. It is mainly to cope with the home demand that night shifts are being run at some of the works, and that overtime is the rule at others, though export business is reported to be fairly satisfactory. An increased number of commercial vehicles is being turned out from Midland shops, the output last month from one factory in the Birmingham area being not far short of the total export of such cars from the United Kingdom last year. In the Coventry area, while certain firms are busy, others report much room for improvement.

Cannock Chase Coal Slump.

A decided slump has set in in the Cannock Chase coalfield, and many of the pits are idle three days per week. Over 4000 miners are on the Cannock Employment Exchange register, and the situation shows no signs of improvement. Most, if not all, the pits in the area had an extended Easter holiday reaching to Thursday of this week.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Exports of Textile Machinery.

MAKING due allowance for the fewer working days in February, exports of British textile machinery in March showed a welcome improvement compared with the previous month. Shipments during the month made a total value of £963,000, against £825,000 in February, and £885,000 in March of last year. The increase was more than accounted for in bigger exports of spinning and twisting machinery, shipments of weaving plant being on a reduced scale, compared with the corresponding month of 1926. The improvement occurred in spite of a drop of £57,000 in exports to Russia. An important development in the Japanese market has amply compensated for the loss in the case of Russia, shipments thence during March being valued at nearly £111,000 against only £31,000 in the previous month and £48,000 in March, 1926. The British East Indies were the largest individual market with shipments valued at £143,000, followed by Russia with £132,500, Japan with £111,000, South America with £83,750, France with £68,350, Germany with £57,800, Holland with £53,660, the United States with £52,200, Australia with £30,450, and China with £26,100, exports to "other European countries" amounting in the aggregate to £154,000.

Civil Engineers in Manchester.

Mr. Daniel Adamson was elected chairman, Mr. A. C. Dean honorary secretary, and Mr. H. Mattinson honorary treasurer at the annual meeting of the Manchester and District Association of the Institution of Civil Engineers. The total number of corporate members of the Association, according to the report, remained at approximately 400, with about 130 corporate members subscribing to the funds. The number of student members of the Association is 102. Mr. A. H. D. Markwick, in the course of a paper on "Protective Paints," read at an ordinary meeting of the Association, said that extremely complicated problems were connected with the use of paint, and were only now beginning to be understood after years of research work. The new British standard specifications for paint materials marked a new era, however, and the days when the manufacture of paint was wrapped in secrecy and mystery were slowly giving way to a more reasonable attitude.

Locomotive Builders' Brighter Prospects.

Increased volume of work in hand and more satisfactory prospects are gratifying statements in the report of the directors of Beyer, Peacock and Co., Ltd., locomotive builders, of Manchester. Largely on these grounds it has been decided to pay off arrears of dividend on the preference shares. After making due allowance for debenture interest and depreciation, the net profits at £11,197 are not much in advance of those for 1925, but with the help of £14,000 from the reserves, £17,520 against £7973 brought forward, and carrying forward only £1467 compared with £17,520 a year ago, the directors are able to pay the preference dividend arrears, amounting in all to £41,250. The recent rumours regarding important South African developments in connection with Messrs. Beyer, Peacock would appear to be confirmed by the cabled news from Pretoria of the registration of a company under the title of Beyer, Peacock (South Africa) Proprietary, Ltd., to carry on the construction of locomotives and other branches of engineering.

Non-ferrous Metals.

The non-ferrous metals market reopened after the holiday break on a somewhat better tone than at the close of last week. In the case of tin the demand for industrial purposes has been on a small scale, and galvanisers continue to buy sparingly in view of the relatively limited sales of their own products at the present time. The margin between spot and forward metal is being steadily reduced, and with a gain of about £3 per ton in the latter and of rather more than £2 in the case of "cash," the difference between the two has been reduced to about £6 10s. per ton, compared with over £15 four or five weeks ago. Copper has also registered a recovery, and at the time of writing values are in the neighbourhood of £1 a ton higher than they were at the corresponding date of last week. United States advices have had a bullish influence on the market, but considering the broken week there has been a fair amount of buying going on, with cable makers taking moderately good quantities. Spelter has gained a certain amount of ground, though less because of the demand for the metal than on account of reduced offerings. Somewhat similar conditions have operated in the case of lead, prices having kept fairly steady and showing little change on balance.

Iron.

The market for pig iron and manufactured sorts during the past week has been notable chiefly for its dullness, though to some extent this has been due purely to holiday influences. Probably not until the beginning of next week will things get back to normal. There has been little change in the basic position, however, and the trend of business, as before, is merely to buy sufficient and little more, to meet early needs. The price position in the case of pig iron continues easy, although in some instances values have not actually been reduced compared with those quoted here a week ago. Midland brands—Derbyshire and Staffordshire—for example, are still on offer at from 89s. to 90s. per ton, delivered Manchester or equal, and Middlesbrough at 92s. 8d. Scottish makes, however, can now be bought at down to 102s., though much higher than this is being asked for certain special kinds. Hematites have further weakened, and both East and West Coast are being offered at from 94s. to 95s. per ton delivered. Buying interest in Lancashire bar iron shows no sign of broadening, and certain mills are shut down for the whole of the current week. So far as prices are concerned, these are unaltered at £11 per ton for Crown bars and £10 per ton for seconds.

Steel.

Quietness has also been very noticeable in the steel market, and there is a feeling that, in view of the volume of business that has been passing recently, lower levels of values pretty well all round cannot much longer be delayed. In certain instances the tone is distinctly steadier than in others. Joists and sections are a case in point, but this is due less to the state of the current demand than to the fact that the accumulation of orders is still sufficient to ensure active operations for the next month or so. These are still quoted at about £7 17s. 6d. per ton for early delivery. Basic bars are also maintained at £8 12s. 6d. to £9 per ton, according to size. Small bars re-rolled from imported materials are, however, still a weak section of the market, and down to £8 5s. is now being quoted for these. Ship and tank plates continue easy and £8 7s. 6d. is now pretty well the general quotation for these, though boiler plates are about unchanged at £11 7s. 6d. to £11 10s. The poor demand for galvanised sheets has served to depress prices still further, and 24 gauges have been

offered this week at £14 15s. Continental steels have been in very limited request, and quotations are easy at £5 7s. 6d. to £5 10s. for sheet bars; £5 2s. 6d. to £5 5s. for billets; £5 17s. 6d. to £6 for steel bars; £6 2s. 6d. to £6 5s. for sections; £7 7s. 6d. for Siemens plates; and £7 2s. 6d. for Thomas plates, for cash against shipping documents, and including delivery to users' works in this district.

The Late Mr. Sydney Yates.

The death occurred on the 5th inst. of Mr. Sydney Yates, of the firm of Matthews and Yates, Ltd., Swinton, at the age of thirty-three. Mr. Yates was educated at the Manchester Grammar School and Manchester College of Technology. He served his apprenticeship with Matthews and Yates, Ltd., and ultimately became a director, being mainly responsible for research work and design. He was a member of the Institution of Heating and Ventilating Engineers. He served throughout the war, first as a motor despatch rider and then as a lieutenant in the Signals.

Barrow-in-Furness.

Hematite.

The production of hematite pig iron is proceeding steadily, but orders are still few, deliveries being much heavier than orders at present. The market may liven up a little shortly, and there is one welcome feature, namely, the reduction in price of coke. The heavy cost of fuel has been an important factor in the price of pig iron, and has been the means of keeping consumers out of the market except for immediate deliveries. It remains to be seen if the price of pig iron falls with the price of coke, which customers are undoubtedly waiting for. There is a general opinion that pig iron will be needed in fairly heavy tonnage for some time and far beyond the orders which were placed before production commenced. These orders have not all been filled yet. Very little, if any, stock is accumulating at any of the works and the steel departments at Barrow and Workington are still taking a fair share of the output. Should the steel departments become quieter, then it either means stocks or reduction of the number of furnaces, and it will very likely be the latter, as no firm desires to accumulate stocks. The demand for special qualities of iron remains steady, and manganese is experiencing a fairly good demand. In the iron ore trade there is a regular business which is likely to continue. The steel trade is moderately quiet, and fresh orders are needed if the mills are to continue for any length of time. Workington is engaged on rails, sleepers, &c., and Barrow is making rails, fish-plates, hoop iron and special sections.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Trades.

Although new orders are slow in arriving, the open-hearth steel plants have so much important work on hand that only one day's holiday was taken at Easter. The accumulation of work, following the prolonged stoppage last year, is being mastered, and fresh work is urgently required. There is considerable hesitation about placing new contracts for steel, not because the work is not there, but because buyers anticipate a fall in prices. It is true that quotations for iron and steel have been unchanged for some time, but there is an easier tendency noticeable, and with the market in its present state buyers are disposed to proceed with the utmost caution. The start after the holidays, however, has been accompanied by a greater display of confidence, and the tone of inquiries has been more encouraging. The makers of railway steel complain of a paucity of orders. Tire and axle plants are only partially working, and the particular section of this branch which is disappointing is that concerned with wagons. Private wagon owners are known to be short of stock, but the financial pressure of these days, coupled with the unsatisfactory state of the coal trade, is no doubt retarding the placing of contracts. This is another of those important trade branches which should revive as soon as conditions generally become more settled.

Blast-furnace Coke.

One point that is causing some anxiety to the iron and steel trades is the price of coke. At a recent meeting of the Blast-furnace Coke Sales Association in Sheffield it was decided to adhere to the prices of 22s. a ton at the ovens for three or six months' contracts, and 21s. a ton for twelve months' contracts. There is a very great shortage of coking slacks, owing to the short-time working of the pits, and with the summer season approaching there does not appear to be much chance of the position improving for some time. Pig iron makers in this district have begun to inquire what the cost would be to them of Westphalian coke, which was so extensively used in Sheffield during the coal stoppage. It was found to be of very good quality, though, of course, at that time the price was very high. It is doubtful whether Sheffield could take this coke at the present time, but the fact that the inquiries are being made is significant of the dissatisfaction pig iron makers feel with regard to the position.

Big Iron and Steel Contract.

A contract has been placed with Newton, Chambers and Co., Ltd., of Thorncliffe Ironworks, Chapeltown, for iron and steel work for the gas department of Birmingham Corporation. An official of the company states that the order is for a big sum. It will mean a busy time for a large number of the firm's employees for several months. Many thousands of castings are required, and some of them are wanted immediately. The various shops will therefore enter upon a busy period at once, and for six months or more the firm will be working at full pressure on this contract.

The Lighter Trades.

The lighter trades are fairly well employed, and for some specialised branches there is a good demand. There are indications that an early improvement will soon be seen in the tool trades, one of the biggest firms having been busy for some weeks. The home market for plate and cutlery is meagre, but the position is being saved to a certain extent by the placing of colonial business. At an exhibition organised by the local Chamber of Commerce in conjunction with the Department of Overseas Trade, which was held in Sheffield recently, there was a display of stainless steel table and dessert knives made in Solingen and purchased in the Argentine. It was certainly encouraging to hear a well-known Sheffield cutlery manufacturer state that Sheffield-made cutlery can be offered in the Argentine at less price than that of the German product. Samples of this German stainless cutlery have been analysed at the Brown-Firth Research Laboratories in Sheffield, and the steel has been pronounced inferior in quality to the Sheffield product.

Cornish Granite Contract.

The famous granite quarries at De Lank, Cornwall, were acquired eighteen months ago by Thos. W. Ward, Ltd., Sheffield, and the firm has just secured from Sir Robert McAlpine and Sons (London), Ltd., an order to supply the whole of the granite for the new dock improvements at Tilbury. The special suitability of this granite for civil engineering and public works has caused it to be used in many important structures.

Tramway Extension.

Sheffield Corporation tramway department has completed an important development which carries the service through some of the beautiful country surrounding the steel city. There was some controversy as to whether omnibuses or trams should be the means of transport, but the Corporation decided on the latter. The new permanent way has cost £54,000, and among the material used were 740 tons of rails, which cost over £10 per ton, nearly 1500 tons of cement, and over 10,000 tons of other material. The scheme has necessitated the laying of 17,400 yards of asphalt, and the excavation of over 10,000 cubic yards of soil. All the work has been done by the Corporation highway department. Another local scheme nearing completion is that of new public baths in the city which have cost £30,000. The boilers and machinery are mainly installed, with the pipes for the supply of hot and cold water, in an extensive subway all round the swimming bath. An up-to-date filtration plant ensures an abundant continuous supply of clean water.

Collieries' Water Supply.

The Staveley Coal and Iron Company has begun excavating a large reservoir at its Markham Collieries, from which to supply the boilers of the collieries with water. At present the collieries draw their water supply from the river. Extensive developments are being carried out at the Markham group of collieries, and it is expected that before the end of the year the output of coal will be considerably more than that of any other group of collieries in the country.

Pit's Improved Output.

In the week before Easter the Silverwood Pit of the Dalton Main Collieries, Ltd., near Rotherham, for the first time since the termination of the miners' dispute, worked a full week of six days, producing an output of 29,000 tons of coal, which is a record since 1912. The average output is 25,000 tons weekly.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

The trade position in the North of England presents few new features. Industrial operations, of course, have been curtailed this week by the Easter holidays, but all the works are in full swing again, with active employment assured for some months ahead. Particularly encouraging is the revival in the shipbuilding industry. More and more orders for new vessels continue to be placed, and some of the shipyards on the North-East Coast have now enough work in hand to keep them fully employed over the next two years. The revival in this industry is also welcomed by steel makers, for shipbuilding activity invariably denotes prosperity for the steel trade. If the shipyards are busy the steel works can never be wholly idle.

Cleveland Iron Trade.

The business done in the Cleveland pig iron trade this week has been very restricted, and the general position is absolutely unchanged. Producers still have sufficiently healthy order books to insure the disposal of the bulk of their output, and they are content to rely upon day-to-day orders to get rid of the balance. Consumers are equally content to go on buying from hand to mouth till prices fall. There is no doubt, however, the producers are getting somewhat anxious as to the future. The fact is that contracts are not coming in to take the place of those that are being rapidly worked off, and unless there is some improvement in the buying position during the next few weeks, some of the makers may be in a difficulty so far as future operations are concerned. Consumers still complain of the high prices, but the present attitude of makers is that wages have advanced and they can make no price concessions until there is some sensible relief in the cost of production. As against this is the fact that Cleveland iron is still shut out of foreign markets, and is being undersold at home by cheap continental iron which is still being imported in considerable quantities. Prices are unchanged, No. 1 being 82s. 6d.; No. 3 G.M.B., 80s.; No. 4 foundry, 79s.; and No. 4 forge, 78s. 6d. per ton.

Hematite Pig Iron.

Quietness also characterises the East Coast hematite pig iron trade. The home market is not sufficient to absorb the whole of the present output, and there is a very limited demand from the Continent for ordinary mixed numbers, most of the inquiries being for iron of special analysis. The consequence is that there is very keen competition amongst the hematite makers for orders, and the price of East Coast mixed numbers is now easy at 83s. per ton, which makes it relatively much cheaper than the ordinary foundry grades.

Ironmaking Materials.

Imports of foreign ore continue on a heavy scale, but new business is slow. Merchants, however, are all heavily sold, and prices are well maintained, best Rubio ore being 22s. per ton c.i.f. Tees. Coke prices show no sign of a further fall, 24s. per ton being still a bedrock figure for good Durham brands delivered at the works.

Manufactured Iron and Steel.

The steel works are operating at high pressure. They have big orders to execute, and the recent orders placed with shipbuilders and engineers promise a continued demand for steel. But apparently some buyers at least are hoping for price reductions. Others possibly are waiting until they get delivery of material already on order. There is, however, no suggestion of easier prices so far as producers are concerned, and all quotations are unchanged.

The Coal Trade.

There is no improvement in the Northern coal trade, and the general direction points to a considerably disappointing forward outlook. Fitters in practically all sections find the utmost difficulty in securing trade to keep the pits working at a moderate average, and in many instances the prospects only point to one or two days' work per week. The Northumberland position is disappointing, and if anything matters are rather worse on the whole in the Durham district. There is an almost total lack of demand from continental centres, and in many overseas areas stocks of coal are abundant and increasing owing to general lack of consumption and over-production. The general curtailment of output as a result of the Easter holidays has not had the slightest effect in steadying prices. With few exceptions every grade of coal can be readily secured at discounts on recent indicated values. Northumberland steam coals are plentiful and easy in price at 15s. for best qualities. There is a quietly steady trade for smalls, but whilst production is low prices show no increase, but remain firm. For gas coals the position is very dull, but production is kept to minimum requirements. Best qualities are quoted at 17s., and secondary at 15s. to 15s. 6d. Unscreened bunkers are in slow demand, good ordinary being offered at 15s., and bests and specials at 15s. 6d. to 16s. 6d. There is a fairly active demand for coke, both for prompt and forward export trade, while the home requirements continue in a steady volume. The output is considerable, and fully equal to requirements. Gas coke for prompt is 22s. to 23s., according to grade and actual dates of shipment; forward over the first month or two, 21s. to 22s.; and for over the remainder of the year, 20s. to 21s. Foundry cokes are moving steadily. Patent coke, ordinary, is 23s. to 25s.; best, 28s.; and beehive coke, 30s. to 37s. 6d.

SCOTLAND.

(From our own Correspondent.)

Dull Markets.

In almost all departments of trade buyers are holding off, and this year to date has been disappointing in respect to new business. Many steel works are fully occupied on existing contracts, and may not be able to accept orders for early delivery, but the ironworks are not so well placed, and it must be assumed that the level of prices does not yet appeal to buyers, despite recent reductions. It is thought that the present inaction is only a passing phase, as consumers of steel and iron must have a considerable amount of business to place, and works now engaged at high pressure must eventually be on the lookout for fresh commissions. Meanwhile, markets are decidedly dull.

Steel.

The actual position at the steel works is unchanged. The demand, especially for shipbuilding material on account of orders placed some time ago, is overwhelming, and the output is more than taxed. Makers have still numerous orders to fulfil, but are not booking fresh business at anything approaching the present rate of output. Under Association agreement the prices of ship plates and sections for home delivery are £8 7s. 6d. and £7 17s. 6d. per ton respectively, but the agreement also allows makers to deduct 5s. per ton in either case, if necessary.

Steel Sheets.

Most varieties of steel sheets are now only moderately busy. Exporters are said to be withholding orders, and it is thought that it may become necessary to resort to price-fixing in order to circumvent the aims of merchants, who, it is said, have plenty of orders to place.

Bar Iron.

The market for bar iron is most unsatisfactory. The current price of £11 5s. per ton for home delivery has failed to produce much business, and it is probable that a further reduction will be deemed necessary as only a small proportion of the plants is engaged meanwhile. Export quotations are also on the level of £11 5s. per ton. The steel re-rolling departments are likewise inactive, and prices are now said to be considerably easier than the recent level of £8 7s. 6d. per ton, home or export.

Pig Iron.

The number of furnaces in blast in Scotland now stands at thirty-four. Outputs are comparatively good,

and only in the case of hematite is there any occasional shortage. Prices are comparatively steady, but foundry qualities show an easier tendency. Since the beginning of April imports of pig iron from India have totalled approximately 2500 tons.

Iron: Imports and Exports.

Imports of iron from Antwerp and Hamburg since April 1st aggregate about 4500 tons, while exports to Australia, New Zealand, India, South Africa, Japan, South America and the West Indies total more than double the imports. Large shipments of tubes to Australia are reported.

Coal.

The coal market shows little change. Prices may be a shade steadier, but this is probably due to restricted outputs and not to any increase in business. Idle time is still prevalent, and the absence of business causes some uneasiness. Best Lanarkshire splints are moderately steady, but most other West of Scotland fuels can be bought below colliery quotations. In the East of Scotland Lothians steams are reported firmer, but the feature in both the Lothians and Fifeshire is the strong position of washed nuts, especially trebles. Aggregate shipments for the week amounted to 229,963 tons, against 252,434 tons in the preceding week and 238,701 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Docks Activity.

THE holidays have brought about a practical suspension of business, and it will be next week at the earliest before anything like settled conditions prevail in the coal trade. The Easter vacation was responsible for approximately the loss of four days' output of coal, and this means from 500,000 to 700,000 tons, which, of course, will be felt on the market. Colliery salesmen certainly expect that values of coal for shipment immediately after the holidays will be very steady, and for this reason they will hold out for recent prices. It is scarcely likely that many of the collieries producing the superior grades of coal will have much to offer for shipment this month, as it is well known that they have fairly full order books, and a fair amount of tonnage has already been taken up for early loading. The figures for shipments this month should turn out very satisfactorily, notwithstanding the holidays. The month of March was certainly good, inasmuch as the quantity of coal shipped as cargo for foreign destinations amounted to 2,262,033 tons, which was the highest figure since July, 1924. A further improvement was noted in the early part of this month, as for the week ended the 10th inst., the shipments of coal and coke from the six principal ports of this district came to 698,050 tons, which was the highest total reached since the early part of 1924. Loading activity at all the ports has been quite brisk. In addition, the import trade has been more active than for some time past, the returns showing that the supplies of pitwood, grain and ore have lately touched a record for the current year, while general cargo trade has also been very satisfactory.

Anglo-Spanish Trade.

The new Anglo-Spanish Commercial Treaty is the subject of a circular issued by the secretary of the South Wales Coal Exporters' Association. This circular states that for several months past negotiations have been taking place for a renewal of the treaty. During this period the directors have had the subject under constant examination, and by correspondence and deputation have done their utmost to ensure that the coal interests of this country should be adequately protected. A new agreement was definitely arrived at on April 5th, and will become operative at midnight, the 23rd–24th inst. The agreement is for no fixed period, but will remain in force until such time as three months' notice to terminate it may be given by either party. As far as coal is concerned, the agreement provides that up to 750,000 tons of British coal may be annually imported into Spain on payment of an import duty which is "40 per cent. less than the rates of the second column of the Spanish tariff in force at any time." The present treaty differs from the 1921 agreement in so far as the latter stated specifically that 750,000 tons of British coal might be annually imported into Spain at an import duty of 4 gold pesetas per ton. At the suggestion of the Association, the British Government has impressed on the Spanish Government the necessity of settling rebates on British coal with the least possible delay.

Coal Board Independent Chairman.

The announcement is made that the Lord Chief Justice of England has appointed, as independent chairman of the Conciliation Board for the coal trade of this district, Sir Francis Taylor, K.C., K.B.E., Vice-president of the War Compensation Court, Chairman of Shropshire Quarter Sessions and presiding Judge of the Liverpool Court of Passage. This appointment has been made under the new Conciliation Board agreement arrived at between the South Wales coalowners and the South Wales Miners' Federation. The agreement provided that should both sides of the Board fail to agree upon an independent chairman, the nomination and appointment should rest with the Lord Chief Justice of England. In the case of the North Wales Wages Board, the Mines Department has appointed Judge R. M. Roberts as the independent chairman. This Board will meet shortly to consider an application by the North Wales miners for a 50 per cent. increase in the minimum rate of wages.

Coalfield Developments.

It is reported that the Powell Duffryn Steam Coal Company is about to carry out an important scheme for the extension of the by-product plant at the Bargoed Collieries. It is stated that an additional set of fifty ovens is to be installed at a cost calculated between £60,000 and £70,000, these ovens being capable of carbonising between 350 and 400 tons of coal per day. It is also reported that the Blaenavon Company's Otto ovens which when working provide employment for about 120 men, are to resume activity very soon after the holidays. This news is very satisfactory, as these men have been idle since the end of 1924.

Coal *v.* Oil.

In a statement issued by Mr. Finlay A. Gibson on the question of the diminished consumption of coal for bunkering purposes, and the reduced consumption of British and Welsh coals on the Continent, it is pointed out that reductions are continually being made by foreign coal producing countries in their railway rates to the competitive coal markets. The policy pursued by Germany and France is also being followed by Poland and Belgium, and through rates at which Silesian coal is now reaching not only Italy, but also Western European markets, are injuring British coal trade interests. In this country a contrary policy has been followed. As regards the competition of oil prior to the war, the British Admiralty purchased from South Wales between three and four million tons of coal per annum, chiefly large coal, whereas for the present year the naval demand is estimated at about only half a million tons. Returns show that the exports from the Bristol Channel ports to the liner bunkering ports of Liverpool, Southampton and London were as follows:—London: 1913, 773,922 tons; 1925, 369,869 tons. Liverpool: 1913, 341,609 tons; 1925, 60 tons. Southampton: 1913, 499,180 tons; 1925, 207,220 tons. The decrease is about 65 per cent., and there has also been an almost corresponding decrease in the shipments of South Wales coal to naval bunkering depôts abroad. The use of oil fuel has, of course, rapidly increased for bunker purposes. In 1925 the fuel oil shipped by British and foreign steamers at British home ports alone represented the displacement of nearly 1¼ million tons of coal, and as this would have been to a predominating extent large coal, it will be easily realised how serious is the problem with which the mining industry is faced in finding new markets for this displaced consumption.

Current Business.

For all practical purposes business on the coal market came to a standstill by the middle of last week. Only small parcels changed hands, these being required to complete cargoes already arranged for loading. The Coal Exchange reopened on Tuesday of this week, but there was very little activity prevailing. Colliery salesmen have very little coal to offer for prompt shipment, and they prefer to wait until they can see what outputs are like at the pits. The market consequently is little more than nominal, and it will be next week before the conditions become settled. Pitwood is a shade steadier at 32s. to 33s.

LAUNCHES AND TRIAL TRIPS.

CASTILLA, steamer; built by Workman, Clark and Co., Ltd., to the order of the United Fruit Company, of Boston; dimensions, 355ft. by 48ft. by 31ft. 6in.; 4200 gross tonnage; trial trip, March 30th.

KINGDOC, single screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steamships, Ltd., of Ontario, Canada; dimensions, 253ft. long. Engines, inverted marine type, with three cranks; constructed by the builders; launch, April 2nd.

BRITISH COLONY, oil tank steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the British Tanker Company, Ltd.; dimensions, 454ft. by 57ft. beam; 10,000 tons deadweight. Engines, triple expansion; constructed by the builders; launch, April 4th.

BEN-MY-CHREE, passenger steamer; built by Cammell Laird and Co., Ltd., to the order of Isle of Man Steam Packet Company; dimensions, 355ft. by 46ft. by 26ft. 6in.; to carry 2400 passengers. Engines, two sets of Parsons single-reduction geared turbines; constructed by the builders; launch, April 5th.

LACHINEDOC, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steamships, Ltd., Ontario, Canada; dimensions, 253ft. long. Engines, inverted marine type, with three cranks; constructed by MacColl and Pollock, Ltd.; launch, April 5th.

PORT FREMANTLE, twin-screw motor vessel; built by Workman, Clark and Co., Ltd., to the order of the Commonwealth and Dominion Line, Ltd.; dimensions, 495ft. by 63ft. by 43ft. 4in.; 11,000 tons deadweight. Engines, two sets of four-cylinder, two-stroke cycle, airless injection, opposed-piston Doxford type; constructed by the builders; trial trip, April 5th.

VALIANT, stern-wheel steamer; built by Lobnitz and Co., Ltd., to the order of the Crown Agents for the Colonies; launch, April 5th.

PAUA, twin-screw motor vessel; built by Harland and Wolff, Ltd., to the order of the Anglo-Saxon Petroleum Company, Ltd.; dimensions, 205ft. by 36ft. 6in. by 15ft.; 1155 gross tonnage. Engines, four-stroke cycle, six-cylinder; constructed by the builders; launch, April 14th.

CONTRACTS.

STANDARD TELEPHONES AND CABLES, Ltd., of Bush House, Aldwych, London, W.C. 2, has received from the Polish Broadcasting Company (Polskie Radio), an order for a 10 kilowatt broadcasting station to be erected at Katowice. This equipment will be manufactured in London.

THE GENERAL ELECTRIC COMPANY, Ltd., of Magnet House, Kingsway, London, W.C.2, has received orders for twelve months' supply of filament lamps of various kinds from the Brentford Union, the Borough of Holborn, the Belfast Union, and the London, Midland and Scottish Railway.

JAMES POLLOCK, SONS AND CO., Ltd., of 3, Lloyd's-avenue, London, E.C. 3, have received an order to build a steel motor canal and river tug barge, to carry approximately 56 tons deadweight on 4ft. 6in. draught, and to be suitable for towing two loaded barges, each to carry about 80 tons. The propelling machinery of the vessel is to consist of a 90 brake horse-power Bolinder two-cylinder engine.

Catalogues.

ALFRED WISEMAN, Ltd., Glover-street, Birmingham.—Leaflet on "Fenlin" noiseless gears.

HANS RENOLD, Ltd., Didsbury, Manchester.—A complete catalogue of the firm's products.

THE COOK JOINT COMPANY, 56, Kingsway, W.C. 2.—Price list of type "A" flexible pipe joints.

E. BROOK, Ltd., Empress Works, Huddersfield.—Publication No. 149, "Brook Motors of Merit."

THE VAUGHAN CRANE COMPANY, Ltd., Openshaw, Manchester.—Booklet on hand-power pulley blocks.

DONOVAN AND CO., Cornwall-street, Birmingham.—List No. 1127 of electric light fittings of all types.

ADAM HILGER, Ltd., 24, Rochester-place, London, N.W. 1.—Bulletin of development, December, 1926.

W. J. FRASER AND CO., Ltd., Dagenham, Essex.—General catalogue of chemical plant and apparatus.

WILLIAM ASQUITH AND CO. (1920), Ltd., Halifax.—List T.G. 102 dealing with the Asquith twist drill grinder.

REAVELL AND CO., Ltd., Ranelagh Works, Ipswich.—Leaflet No. 143 on electric and hand-driven garage pumps.

HENRY WELLS OIL COMPANY, Ltd., 11, Haymarket, S.W. 1.—Brochure on the new "Filmac" patent cutting oil.

FOAMITE FIREFOAM, Ltd., 24, Maddox-street, W. 1.—Booklet dealing with fire protection for oil-burning and motor ships.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria-street, S.W. 1.—A.C.E.C. *Quarterly Review*, No. 112.

NATIONAL GAS ENGINE COMPANY, Ltd., Ashton-under-Lyne.—Catalogue No. 251B, dealing with horizontal heavy-oil engines.

SPENCER (MELKSHAM), Ltd., Melksham, Wilts.—Brochure showing modern methods of handling and storing grain, ore, coal, sacks, &c.

C. G. VOKES AND CO., 38, Conduit-street, W. 1.—Brochure introducing the "Protectomotor" high-efficiency industrial air filters.

THE BRITISH ALUMINIUM COMPANY, Ltd., Adelaide House, King William-street, E.C. 4.—Data sheets of aluminium sections and matting.

LEA RECORDER COMPANY, Ltd., 28, Deansgate, Manchester.—Booklet M.L. for economy in steam "production," "consumption," and "destruction."

CECIL HODGES AND CO., Ltd., Empire Works, Dalston, London.—Folders 109/12 and 132 dealing with different sizes of "Empire-light" electric lighting plants.

AUTOMATIC AND ELECTRIC FURNACES, Ltd., 173–175, Farringdon-road, E.C. 1.—Section H of catalogue dealing with Wild-Barfield small electric furnaces.

THE UNITED MACHINE TOOL COMPANY, Ltd., 14, Holborn Hall, Gray's Inn-road, W.C. 1.—List No. 604 on "Hille" multiple-spindle drilling machines.

THE PATERSON ENGINEERING COMPANY, Ltd., Windsor House, Kingsway, W.C. 2.—Fifth edition of the booklet entitled "The Purification of Industrial Waters."

HOFFMANN MANUFACTURING COMPANY, Ltd., Chelmsford, Essex.—Novelty card showing the principle of the Hoffmann ball and roller line shaft bearings.

THE ALBION MOTOR CAR COMPANY, Ltd., Scotstoun, Glasgow.—Specification of the 1927 model 30/60 horse-power, twenty-passenger "Viking" motor coaches.

WILLIAM C. JONES, Ltd., Collyhurst Waste Mills, Manchester.—A sample packet of cotton waste and a booklet giving particulars of the various grades supplied.

KRYN AND LAHY METAL WORKS, Ltd., 34, Corporation-street, Birmingham.—Pamphlet illustrating the firm's factory and showing the types of work undertaken.

BURMEISTER AND WAIN, Ltd., Copenhagen, Denmark.—A booklet illustrating and describing the firm's works and giving particulars of various ships constructed by it.

THE ELECTRICAL EQUIPMENT AND CARBON COMPANY, Ltd., 109–111, New Oxford-street, London, W.C. 1.—Illustrated pamphlet describing the new Rosenberg welding generator.

SCOTT AND HODGSON, Ltd., Guide Bridge Ironworks, near Manchester.—Catalogue of the firm's manufactures, including steam engines, barring engines, heavy castings, and small steam turbines.

A. J. AMSLER AND CO., Schaffhouse, Switzerland.—A copy of pamphlet D.W. 26E, which contains a description in English, with illustrations and diagrams, of the Amsler railway dynamometer car.

MAGNESIUM FLOORING MATERIALS ASSOCIATION, 106, Fenchurch-street, E.C. 3.—Booklet entitled "Composition Floorings," giving facts in relation to jointless flooring and magnesium composition.

HOLLINGS AND GUEST, Ltd., Thimble Mill-lane, Birmingham.—A number of the firm's latest illustrated lists dealing with all types of hydraulic machinery and various other specialities manufactured.

BERNARD HOLLAND AND CO., 17, Victoria-street, S.W. 1.—Booklet issued by the firm's principals—the Swiss Locomotive and Machine Works—giving detailed information on the "Abt System" of rack railways.

W. CROCKATT AND SONS, Ltd., Darnley-street, Glasgow, S. 1.—A description of the "Crockatt Simplex" patented electric salinometer for indicating any impurity in the condensate and the boiler feed water.

BRUNTONS, Wire Rope Works, Musselburgh, Scotland.—A bound catalogue of 130 pages containing full particulars of all types of wire ropes, details of their manufacture and the work for which they are best suited.

DAVID BROWN AND SONS (HUDDERSFIELD), Ltd., Park Works, Lockwood, Huddersfield.—A treatise on the design, manufacture, and application of double helical gearing, with special reference to "D.B.S." reducing gears and turbine gears.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., 82, York-road, N. 1.—A reprint from the *Railway Gazette* entitled "A New Development in Single-line and Either-way Working," also catalogue S. 14 on the electro-pneumatic operation of points and signals.

WAILES DOVE BITUMASTIC, Ltd., 5, St. Nicholas'-buildings, Newcastle-on-Tyne.—Catalogue illustrating various buildings and structures upon which the use of Bitumastic has been successful; also containing an illustrated list of the colours in which "Bitumastic" can now be supplied.

THE ROYAL GOLD MEDAL FOR ARCHITECTURE.—The Royal Institute of British Architects announces that His Majesty the King has approved the award of the Royal Gold Medal to Sir Herbert Baker, A.R.A., F.R.I.B.A., in recognition of the merit of his work as an architect. The medal will be presented to Sir Herbert Baker at the banquet of the R.I.B.A. on June 23rd.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 5 0 to 4 7 6	
No. 1 Foundry	4 11 6	—
No. 3 Foundry	4 0 6	—
N.E. COAST—		
Hematite Mixed Nos.	4 3 0	4 3 0
No. 1	4 3 6	4 3 6
Cleveland—		
No. 1	4 2 6	4 2 6
Silicious Iron	4 2 6	4 2 6
No. 3 G.M.B.	4 0 0	4 0 0
No. 4 Foundry	3 19 0	3 19 0
No. 4 Forge	3 18 6	3 18 6
Mottled	3 17 6	3 17 6
White	3 17 6	3 17 6
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	4 0 0	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 19 0 to 4 0 0	
Foundry Forge	3 10 0	—
(3) Derbyshire—		
No. 3 Foundry	4 1 0 to 4 2 6	—
Forge	3 15 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 1 6	—
No. 4 Forge	—	—
Basic	4 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 17 6 (a); 5 0 6 (b); 5 4 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	—
Best	—	—
N.E. COAST—		
Iron Rivets	12 15 0	—
Common Bars	11 15 0	—
Best Bars	12 5 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 0 0 to 11 5 0	
Best Bars	12 5 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	11 5 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	12 10 0 to 12 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¾in. and up	8 7 6	£8 0 0 to 8 5 0
Sections	7 17 6	£7 10 0 to 7 15 0
Steel Sheets, under 3/16 in. to ¼in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 0 0 to 16 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 10 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0	
MANCHESTER—		
Bars (Round)	9 0 0	—
,, (Small Round)	8 5 0	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 15 0	10 15 0
Plates	8 7 6	—
,, (Lancs. Boiler)	11 7 6	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 10 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	8 10 0 to 8 15 0	
Billets and Sheet Bars	7 0 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 0 0 to 15 5 0	
Angles	7 15 0 to 8 0 0	
Joists	7 15 0 to 8 0 0	
Tees	8 15 0 to 9 0 0	
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 19/9
Block Tin (cash)	303 10 0
,, (three months)	296 10 0
Copper (cash)	54 16 0
,, (three months)	55 7 6
Spanish Lead (cash)	26 18 9
,, (three months)	27 8 9
Spelter (cash)	29 12 6
,, (three months)	30 0 0
MANCHESTER—	
Copper, Best Selected Ingots	61 5 0
,, Electrolytic	62 12 6
,, Strong Sheets	86 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	28 5 0
,, Foreign	27 5 0
Spelter	30 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 10 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,,Max. 2 p.c. carbon	£36 6	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	15/–
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£16 for home,	£16 for export
,, Silicon, 45 p.c. to 50 p.c.	£11 17 6 per unit	scale 5/– per
,, ,, 75 p.c.	£19 0 0 per unit	scale 6/– per
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/– per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/9
,, ,, Ell	15/3
,, ,, Splint	15/9 to 17/–
,, ,, Trebles	14/6
,, ,, Doubles	13/9
,, ,, Singles	13/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/–
,, ,, Jewel	16/6
,, ,, Trebles	14/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/9 to 14/6
Screened Navigation	21/–
Trebles	14/–
Doubles	13/6
Singles	13/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/9
Secondary Steam	13/–
Trebles	14/–
Doubles	13/6
Singles	13/3

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	27/6
Household	42/6 to 58/6
Coke	29/– to 30/6
NORTHUMBERLAND—	
Best Steams	15/–
Second Steams	14/6
Steam Smalls	10/6
Unscreened	14/6 to 15/–
Household	21/– to 27/–
DURHAM—	
Best Gas	17/– to 17/6
Second	15/6 to 16/–
Household	21/– to 27/–
Foundry Coke	24/6 to 26/6
SHEFFIELD—	
Best Hand-picked Branch	32/– to 34/–
Best Selected House Coal	25/– to 27/6
Screened House Coal	23/– to 24/–
,, ,, Nuts	18/6 to 19/6
Yorkshire Hards	18/– to 19/–
Derbyshire Hards	18/– to 19/–
Rough Slacks	11/– to 12/–
Nutty Slacks	8/– to 9/–
Smalls	3/– to 5/6
Blast-furnace Coke (Inland)	22/– to 27/6 at ovens.*
,, ,, (Export)	f.o.b. 28/– to 30/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	23/– to 23.9
Second ,, ,,	22/6 to 23/–
Best Dry Large	21/– to 21/6
Ordinary Dry Large	20/– to 21/–
Best Black Vein Large	22/– to 22/6
Western Valley Large	20/6 to 21/6
Best Eastern Valley Large	20/– to 20/6
Ordinary ,, ,,	19/– to 20/–
Best Steam Smalls	14/3 to 14/9
Ordinary Smalls	13/– to 14/–
Washed Nuts	18/– to 22/–
No. 3 Rhondda Large	25/– to 26/–
,, ,, Smalls	16/6 to 17/–
No. 2 ,, Large	21/– to 21/6
,, ,, Through	18/– to 19/–
,, ,, Smalls	13/– to 14/–
Foundry Coke (export)	40/– to 45/–
Furnace Coke (export)	30/– to 32/6
Patent Fuel	25/9 to 26/6
Pitwood (ex ship)	31/– to 32/–
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	37/6 to 42/6
Seconds	32/6 to 35/–
Red Vein	27/– to 29/6
Machine-made Cobbles	42/6 to 47/6
Nuts	42/6 to 45/–
Beans	40/– to 43/–
Peas	21/– to 23/–
Breaker Duff	9/– to 9/6
Rubbly Culm	11/6 to 12/–
Steam Coals :	
Large	21/6 to 22/6
Seconds	19/6 to 21/6
Smalls	12/6 to 13/6
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 22/– per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

Paris Water Supply.

THE Paris Municipal Council has adopted the recommendation to ask Parliament to declare the scheme for bringing water from the Vals de Loire a "work of public utility." There was some opposition from the group that favours the construction of barrage reservoirs in the upper valley of the Seine, and although the Municipal Council accepted in principle a year ago the creation of reservoirs, and declared its intention of voting the funds for the construction of one or two experimentally, it is evident that nothing will be done so long as there is some hope of putting in hand the Vals de Loire scheme. Along the left bank of the Loire, between Nevers and Gien, a number of wells will be sunk at distances ranging from 50 m. to 300 m. from the river. The subterranean water will be pumped into an aqueduct of increasing section until it crosses the Loire a little above Gien, and from that point the main aqueduct will run for a distance of about 87 miles to the south of Paris, where there will be two large reservoirs. It will provide one million cubic metres of water a day. Under the most favourable conditions the cost of the undertaking is not likely to be less than 1500 million francs, and the annual expenditure is estimated at 8,400,000f. The financial side of the scheme offers the greatest difficulty, and, in the hope that some means will be found of carrying it out, the object of securing from Parliament a declaration of "public utility" is to enable the Municipal Council to complete the preliminary investigations.

Naval Construction.

The vessels to be put on the stocks during the year beginning June 30th next, if the credits are voted in time, differ slightly from those provided for under the Naval Statute. According to the Statute, the ships to be put in hand during 1927 were to consist of one 10,000-ton cruiser, three destroyers, four torpedo boats, five first-class submarines, and a submarine minelayer. It is obviously impossible to follow a rigid programme of naval construction over a considerable period without running the risk of including in the fleet types of vessels that lose some of their fighting value through unexpected evolutions in naval strategy. The French continue to attach great importance to the destroyer, which is intended mainly to escort flotillas of torpedo boats and submarines. It is therefore increasing in power, speed, and armament, and appears to be developing into a very light type of cruiser. In place of three destroyers and four torpedo boats it has been decided to build six 2400-ton destroyers of the "Tigre" class. Meanwhile six 1490-ton destroyers of the improved "Simoun" class are nearing completion and three 2690-ton destroyers of the "Jaguar" category have been started upon, these latter with engines of 50,000 horse-power and designed for a speed of 35 knots. The armament will consist of five 138 mm. guns, four of 37 mm., and six 550 mm. topedo tubes. So far as torpedo boats are concerned, it is still under consideration whether it would not be better to build a much larger flotilla of very fast motor boats, each with a fewer number of torpedoes, the idea being to ensure extreme mobility of a flotilla which would concentrate a discharge of torpedoes from a considerable distance. The construction of two "avisos" of about 2500 tons is also a departure from the original programme.

Hydro-electric Schemes.

The failure to carry through the proposal for a national electrification with the aid of hydro-electrical installations has naturally caused considerable disappointment, as a great deal had been made of the fact that a utilisation of the abundant hydraulic power available would render this country independent of foreign coal. It is now seen that, where coal exists, hydraulic power offers little attraction to capitalists. In the South of France, where the cost of coal is increased by freight charges, some important installations have been carried out for the electrification of the Midi Railways, and the Eguzon power station, as well as others to be created on the Dordogne, are contributing to the energy required for the working of the Orleans system. Elsewhere little has been done, and while the demands for hydraulic concessions are dwindling, the big schemes remain in abeyance because the necessary capital is not forthcoming. On the other hand, plenty of capital is available for constructing electrical power stations with steam generators. They cost, roughly, a third of the expenditure involved in the construction of a dam and the laying down of turbines to develop the same power, and the capital brings in an assured return in a much shorter time. Between 1914 and 1923 the power developed by hydro-electrical plants only increased by 85 per cent., while plants with steam generators increased by 414 per cent. The Government recently endeavoured to procure the money required for carrying through the hydro-electrical schemes by imposing a 5 per cent. tax on the consumption of electricity, but the proposal aroused so much opposition that it had to be abandoned and a suggestion was then made that the Government should either raise the money by loans or else provide subsidies out of the Budget. A report has just been prepared on behalf of the Commission des Mines et de la Force Motrice de la Chambre by Monsieur Antoine Borrel, who concludes that it would be preferable to utilise the national funds, and the State would receive shares from the companies in proportion to the amount given as subsidy. The idea is to establish a policy in aid of the carrying out of hydro-electrical installations, but it is evident that the State will not be in a position to render any great financial assistance for some time to come.

The Steel Trade.

While there has been a little more buying of iron and steel, following mainly upon the distribution of orders for railway material, the situation generally has undergone no change, and quotations for export are weakening. At the same time pig iron prices are maintained on account of the high values of coke.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

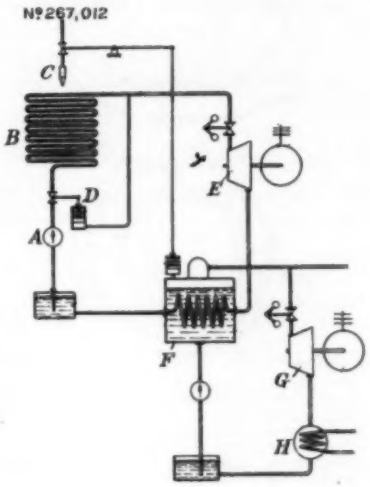
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

267,012. September 10th, 1926.—VAPOUR GENERATING SYSTEMS, Siemens Schuckertwerke Gesellschaft mit beschrankter Haftung, Berlin-Siemensstadt, Germany, and W. Abendroth, 140, Berlinerstrasse, Berlin-Charlottenburg, Germany.

This invention is concerned with the binary fluid system of power generation. In it the primary fluid is evaporated at its critical pressure and temperature, while the secondary fluid is worked below the critical conditions. The primary fluid

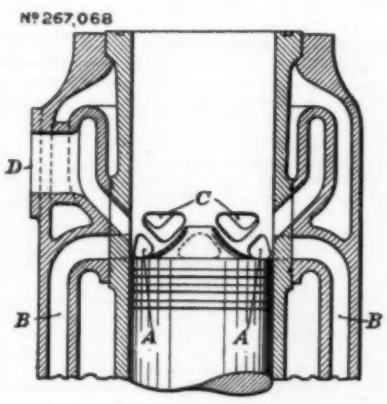


is supplied, at the critical pressure, by the pump A to the boiler B, heated by the burner C. The actual pressure is determined by the governor and valve D. The resultant vapour is used in the turbine E, and the exhaust heats the secondary boiler F in being condensed. The vapour from the boiler F is used in the second turbine G, and is condensed at H. The boiler F is made of large capacity so that it may act as a heat storage, and so allow the turbine G to overcome temporary overloads.—*March 10th*, 1927.

INTERNAL COMBUSTION ENGINES.

267,068. February 8th, 1927.—SCAVENGING TWO-STROKE ENGINES, G. Ferguson, Dunklerstraat, 15, The Hague, Holland.

In this engine both the scavenging air ports and the exhaust ports are of triangular form. The scavenging ports are shown at A A and are supplied through the passages B B. The exhaust ports C C communicate with the outlet D. Owing to the fact that the outlet ports are broad at the top and narrow at the bottom, the downwardly moving piston, at the moment when it begins to open the outlet ports, uncovers a large outlet cross-section and thus permits the products of combustion to escape from the cylinder so rapidly that, after the piston has travelled only a few millimetres further down, the cylinder pressure has



already sunk below the pressure of the scavenging air. This permits the outlet ports to be reduced to a minimum, and also enables the scavenging action to begin as nearly as possible at the same time as the exhaust. The triangular form of the inlet ports facilitates such a result, as, owing to these ports increasing in breadth towards their base a large inlet cross-section is given without increasing the height of the port. Further, since these ports taper towards the top they extend almost to the upper edge of the outlet ports in spite of the breadth of these latter. The whole construction permits the total height of the ports to be very small and with a given total stroke of the engine a valuable improvement in the compression and working strokes is obtained.—*March 10th*, 1927.

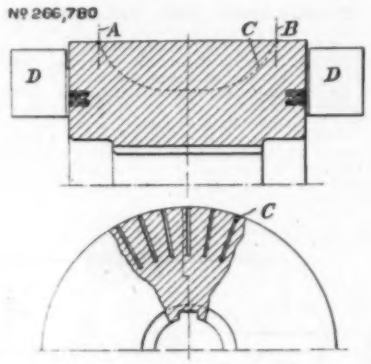
DYNAMOS AND MOTORS.

266,799. November 27th, 1925.—IMPROVEMENTS IN ELECTRIC MOTORS, William Morris Mordey, of 82, Victoria-street, Westminster.

The inventor has found that a multi-phase motor of a very simple form can be made by using an induced element—whether forming the rotating or the stationary portion of the motor—consisting of a simple non-conducting or practically non-conducting block of finely divided or granular magnetic materials without any winding, the material being compressed dry or mixed with a small amount of cement, mucilage, liquid glue, rubber solution, shellac varnish, melted shallac, or other suitable binding material and dried or allowed to set. Good results have been obtained with discs, cylinders or rings made of magnetite powder, pyrrhotite powder, steel or iron filings, steel grit, nickel or cobalt powder or other finely divided highly hysteretic material. A solid block of pyrrhotite rock which is magnetic and highly hysteretic and a non-conductor and therefore need not be pulverised acts quite well. Such elements combined with suitable forms of multi-phase fields, constitute simple and inexpensive motors, the action of which is attributed to hysteresis, as, even when made of metallic substances, eddy currents are practically excluded by reason of the subdivision of the material and by the separation of the particles thereof by the non-conducting binding material. Non-conducting induced elements thus constituted can be used in small polyphase motors or meters and possibly also for larger work. The induced element of such a motor may be in the form of a rotating drum or rotor, or in the form of a stator surrounding a rotating field or inductor. In the first case the drum is made of materials, such as above described, either moulded or compressed into the form of a solid or hollow cylinder, suitably mounted upon a shaft. In the second case, the stator is made of like materials moulded into blocks and built up, or cast or compressed into the required form, and it may be moulded or so made as to be in one piece with the bed-plate and bearings and other fixed parts of the motor.—*February 28th*, 1927.

266,780. November 4th, 1925.—IMPROVEMENTS IN AND RELATING TO ARMATURES FOR ASYNCHRONOUS MOTORS, Claudius Shenfer, 8t, Basmannaja-street, 15, Moscow, Russia, and the English Electric Company, Ltd., Queen's House, 28, Kingsway, London, W.C. 2.

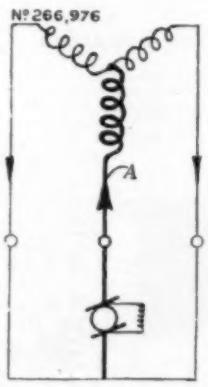
This specification describes a secondary element for an asynchronous motor composed of a solid body. The length



of the rotor that lies inside the core of the stator is that situated between the lines A and B. This part of the body of the rotor has a number of equally spaced narrow and deep slots C, which terminate at a distance from the ends of the core, so as to leave an uninterrupted ring at each end, as indicated in the upper drawing. To these rings fans are attached as shown at D.—*March 4th*, 1927.

266,976. July 5th, 1926.—IMPROVEMENTS IN SYNCHRONISED ASYNCHRONOUS ELECTRIC MOTORS, Jan Rezelman, of 27, rue Destrée, Marcinelle, Belgium.

This invention relates to an improvement in the construction of synchronised asynchronous motors, in which continuous current is employed for the excitation of an inductor circuit formed by the three-phase winding of the rotor or the stator.



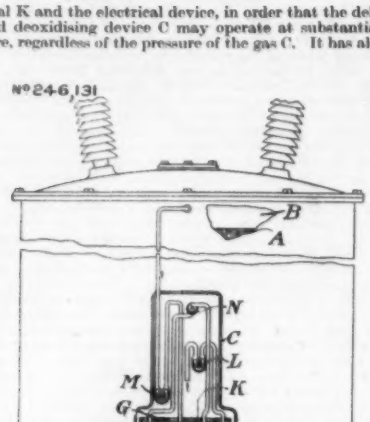
The improvement forming the invention consists in providing unequal slots around the circumference of the inductor, the slots of phase A being larger than those of the other phases. In this manner it is possible to provide the same number of conductors for each of the phases, the conductors of phase A having a larger cross-section than that of the conductors in phases B and C.—*March 10th*, 1927.

TRANSFORMERS AND CONVERTERS.

246,131. January 8th, 1926.—IMPROVEMENTS RELATING TO CONTAINERS FOR ELECTRICAL APPARATUS, *Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.*

The apparatus comprises an electrical device, such as a transformer or circuit breaker, that is partially filled with an insulating oil A, above which there is a confined atmosphere B of inert or oxygen-free air or gas, and a deoxidising and dehydrating device C for rendering air or gas drawn into the electrical device inert or free from oxygen. The deoxidising and dehydrating device comprises a casing having an air vent D and containers E and F, both being covered by a sealing compound G. The container E is filled with a deoxidising compound H and the container F with a deyhdrating material K, such as calcium carbide. A liquid seal L is placed between the atmosphere and the deoxidising material H in order to prevent unnecessary decomposition of the latter by direct contact with the atmosphere, although the seal permits a transfer of air or gas under certain conditions of pressure of the gas B. A liquid seal or pressure regulator M is connected between the dehydrating

material K and the electrical device, in order that the dehydrating and deoxidising device C may operate at substantially air pressure, regardless of the pressure of the gas C. It has also been

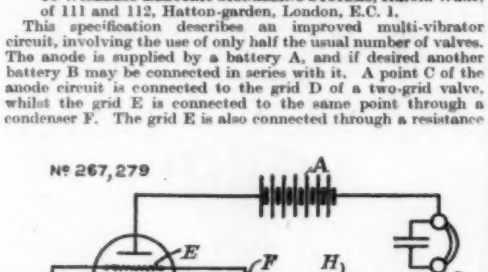


found advisable to insert a barrier or check valve N in the pipe connection between the deoxidising and dehydrating materials. —*March 17th*, 1927.

TELEGRAPHS AND TELEPHONES.

267,279. February 9th, 1926.—Improvements in or relating to Wireless Electric Signalling Systems, Harold Wade, of 111 and 112, Hatton-garden, London, E.C. 1.

This specification describes an improved multi-vibrator circuit, involving the use of only half the usual number of valves. The anode is supplied by a battery A, and if desired another battery B may be connected in series with it. A point C of the anode circuit is connected to the grid D of a two-grid valve, whilst the grid E is connected to the same point through a condenser F. The grid E is also connected through a resistance

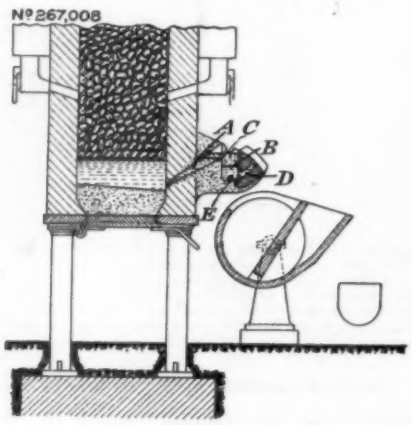


G to the valve filament. The value of the condenser F should be between 2000 centimetres and 1 microfarad, and the resistance H a few thousand ohms. The value of the resistance G should be about 1 megohm. At first the condenser F is charged up rapidly, but with a steadily decreasing speed until a certain difference of potential between its terminals is attained, when a brisk discharge occurs, accompanied by a sudden reversal of the current. The condenser is then charged again, but in the opposite sense, and again discharged, and so on. The low self-induction present in the connecting wires maintains the phenomenon.—*March 17th*, 1927.

FURNACES.

267,008. September 4th, 1926.—Cupolas, W. Dietrich, 15, Zietenstrasse, Dortmund, Germany.

The object of this invention is to separate, so far as is possible, the molten iron and slag in a cupola under the influence of the air blast. With this object an oblique passage A is arranged



from the lower part of the hearth, and it is of a gradually increasing cross-section. This passage communicates with a receptacle B, in which the slag separates out from the iron. The slag flows away by the notch C, and the iron by the passage D. The tapping hole E is provided for draining the receptacle B at the end of a run.—*March 10th*, 1927.

METALLURGY.

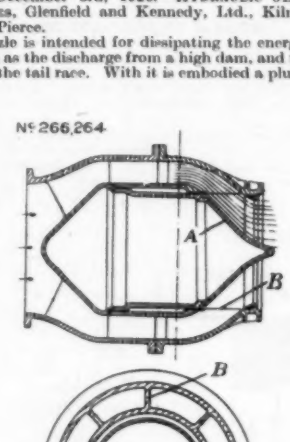
267,433. November 16th, 1926.—Recovery of Metals from Compound Ores, *W. Carpmael, 24, Southampton-buildings, London, W.C. 2.*

This invention is concerned with the recovery of the several metals contained in a compound ore or slag, and consists essentially in grinding and chemically treating the material at one and the same time. The following procedure is given as a typical example :—"To recover the metals from complex sulphide ores, containing zinc, copper and lead as sulphides, the coarsely divided ore is treated in a ball mill with sulphuric acid at a temperature such that at first zinc alone is converted into its sulphate. In this matter a yield of zinc of over 99 per cent. is obtained, without the copper passing into solution. The residue on removal of the liquid is now treated at a higher temperature with a further quantity of sulphuric acid of concentration, such that the copper enters into solution, while the lead remains with the gangue as insoluble sulphate. The process takes place with the evolution of hydrogen sulphide in a concentrated form."—*March 17th*, 1927.

MISCELLANEOUS.

266,264. December 3rd, 1926.—Hydraulic Jet Dispersal Nozzles, Glenfield and Kennedy, Ltd., Kilmarnock, and O. A. Pierce.

This nozzle is intended for dissipating the energy of a jet of water, such as the discharge from a high dam, and thus avoiding damage to the tail race. With it is embodied a plunger valve A.



The dissipating effect is provided by discharging the water as a hollow cone, and this cone is produced by the curvature of the vanes B B. The essential feature of these vanes is that the curvature near the central boss must be greater than that near the periphery, or the proper form of cone will not be produced.—*February 24th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. "The Engineering of Distribution, with Special Reference to Finance as a form of Organisation," introduced by Major C. H. Douglas. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Paper, "Shock Absorber Units for Land Planes," by Mr. C. D. Holland. 7.30 p.m.

SATURDAY, APRIL 23rd.

Institution of Automobile Engineers.—London Graduates' visit to the London and North-Eastern Railway Works, Stratford, E. 15. 2.30 p.m.

Institution of Municipal and County Engineers.—County Hall, Ipswich. Eastern District meeting. 10.45 a.m.

North of England Institute of Mining and Mechanical Engineers.—Newcastle-upon-Tyne. Paper, "The Dry Cleaning of Coal," by Mr. J. S. Carson. 2.30 p.m.

MONDAY, APRIL 25th.

Chemical Engineering Group.—American Film Company, Ltd., 89–91, Wardour-street, London, W. 1. Paper, "Permanent Moulding Machines for Cast Iron," by Professor J. W. Hinchley. 8 p.m.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Graduates' Section meeting. "Parcel and Package Conveying Plant," by Mr. H. W. Cadman. 7 p.m.

Institution of Structural Engineers.—10, Upper Belgrave-street, London, S.W. 1. Students' meeting. Discussion on "The Development of Rapid Hardening Cements," opened by Mr. H. R. Cox. 6 p.m.

Railway Club.—25, Tothill-street, London, S.W. 1. Debate, "That the Grouping of British Railways has not been Beneficial." 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "The Measurement of Light," by Mr. J. W. T. Walsh. 8 p.m.

TUESDAY, APRIL 26th.

Illuminating Engineering Society.—National Physical Laboratory, Teddington. Inspection of the Photometric Section of the Laboratory. Paper, "Work in the Photometry Department of the National Physical Laboratory," by Mr. H. Buckley. 7 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Paper, "Bridge-foundations on Transported Chalk, with Notes on Piled and Monolith Foundations," by Mr. J. P. Porter. 6 p.m.

Junior Institution of Engineers.—Monico Restaurant, Shaftesbury-avenue, London, W. 1. Annual dinner. 6.30 p.m.

WEDNESDAY, APRIL 27th.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Annual general meeting of the Association of London Students. 6.30 p.m.

Institution of Electrical Engineers: South Midland Centre.—The University, Edmund-street, Birmingham. Kelvin Lecture, "High-frequency Currents," by Professor E. W. Marchant. 7 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Fire Waste (Loss of Property by Fire) and its Effects on the Economics of National Life in Great Britain," by Mr. G. E. Keay. 8 p.m.

Society of Glass Technology.—Applied Science Department of the University, St. George's-square, Sheffield. Annual general meeting followed by ordinary meeting. "A Brief Review of Furnace Developments," by Professor W. E. S. Turner. 2.30 p.m.

THURSDAY, APRIL 28th.

Institute of Metals: London Local Section.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Annual general meeting. Discussion on "The Working of Metals," opened by Mr. E. I. Thorne. 7.30 p.m.

Institution of Automobile Engineers.—Training School of Vauxhall Motors, Ltd., Luton, Beds. Luton Graduates' meeting. Paper, "The Internal Combustion Turbine," by Mr. P. White. 7.30 p.m.

Institution of Municipal and County Engineers.—North Wales District meeting at Abergele. 11.30 a.m.

Institution of Structural Engineers.—10, Upper Belgrave-street, London, S.W. 1. Debate, "That the System of Education of Structural Engineers by Articled Pupilage is Contrary to the Best Interests of the Student, and should be Superseded by Education in Recognised Engineering Schools." 8 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington, London, S.W. 7. Address by Sir Samuel Hoare on his recent flight to the East. 5.30 p.m.

FRIDAY, APRIL 29th.

Diesel Engine Users Association.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Further Developments in Mechanical Injection Oil Engines," by Mr. Oswald Wans.

Institute of Metals: Swansea Local Section.—Metallurgical Department of the University College, Singleton Park, Swansea. Annual general meeting. 7.15 p.m.

Institution of Electrical Engineers: Scottish Centre.—Technical College, Bell-street, Dundee. Paper, "Modern Electrical Wiring, particularly as Applied to Small Houses," by Mr. D. S. Munro. 7.30 p.m.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Stress-strain Diagram and its Application to the Testing of Rolling Stock Draw Gear," by Mr. L. H. Evans. 7.30 p.m.

Institution of Locomotive Engineers: Manchester Centre.—College of Technology, Sackville-street, Manchester. Paper, "Laminated Springs," by Mr. T. H. Sanders. 7 p.m.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Paper, "The Failure of Some Steel Wires Under Repeated Torsional Stresses at Various Mean Stresses," by Professor F. C. Lea and Mr. F. Heywood. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Paper, "The Design and Balancing of Three-phase Low-tension Distribution Systems," by Mr. W. Fordham Cooper. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "Wireless Transmission and the Upper Atmosphere," by Dr. E. V. Appleton. 9 p.m.

TUESDAY, MAY 3rd.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Thirty-third James Forrest Lecture, "Some Recent Services of Metallurgy to Engineering," by Professor H. C. H. Carpenter. 6 p.m.

WEDNESDAY, MAY 4th.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Dr. Mann Lecture, "English Railways," by Professor W. E. Dalby. 8 p.m.

THURSDAY AND FRIDAY, MAY 5th and 6th.

Iron and Steel Institute.—Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual meeting. For programme see page 428. 10 a.m. each day.

FRIDAY, MAY 6th.

Chemical Engineering Group.—Imperial College of Science and Technology, South Kensington, London, S.W. 7. Annual general meeting. Paper, "Chemical Fire Extinguishers," by Dr. W. R. Ormandy. 6 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Autocar Electrical Equipment Company, of 115, Old-street, London, E.C. 1, asks us to announce that it has been appointed sole concessionaire for Waltham speedometers and automobile clocks.

The Rev. L. Van Vestraut, M.A., who has for several years been chief assistant in the Testing Department at Faraday House Electrical Engineering College, has been appointed registrar. Mr. F. A. Bell, F.C.A., has been appointed secretary.

Laidlaw, Drew and Co., Ltd., of Gilmour-street (Simon-square), Edinburgh, ask to us announce that they are now officially registered as a limited company, and intend to carry on the business of the late Laidlaw, Drew and Co., under the name of Laidlaw, Drew and Co., Ltd.

Allen-Liversidge, Ltd., asks us to announce that for the year ended December 31st, 1926, each one of the numerous London lorry and van drivers in its employ has been awarded the Diploma of the London Safety First Council for having been free from accidents in the Greater London area.

The Transporting Machinery and Engineering Company, Ltd., of Stanley House, Dean Stanley-street, Westminster, London, S.W. 1, asks us to announce that it has taken over the mechanical handling department of W. Dederich, Ltd., of the same address, and is carrying on the business of that department.

Merchant Steamers at the South Kensington Science Museum.—We have recently received a copy of the new catalogue of the collection of merchant steamers at the Science Museum, South Kensington, which is an illustrated book of some eighty pages, and is complete with descriptive and historical notes compiled by Mr. G. S. Laird Clowes, M.A. Copies may be obtained from the Science Museum of from H.M. Stationery Office. This booklet is the second in the series dealing with water transport, and the exhibits described in it include ocean-going passenger vessels, ocean-going cargo vessels, bulk-oil carriers, vessels for the high seas, and narrow waterways, as well as steam yachts, trawlers, and tugs.